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UARY
1947

In This Issue:

WEED TRAP

***Homesteading—
Then and Now***

***Public Power and
Small Business***

Public Library,
Kansas City, Mo

What of Tomorrow?

THE *Reclamation* ERA

OUR FRONT COVER

What of Tomorrow?

Your guess is as good as that of veteran Dave H. Law, Jr., his wife, or son David James. However, he has a slight margin of hope over most of us because of his reclamation farm on the Deschutes project in central Oregon. To help him develop his land, he and his family will have the advice and help of reclamation land specialists who are cooperating with State and national agencies to help new settlers such as these. Success will not come overnight—but there's a new year ahead.

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Front cover by Stanley Rassmussen, region I; back cover, National Park Service, U. S. Dept. of the Interior; page 3 photo by Barrow Lyons, Chief Information Officer, Bureau of Reclamation; page 4 (top) photo by Barrow Lyons; page 4 (bottom) photo by Ben Glaha, region II; pages 5, 6 and 7 photos by Stanley Rassmussen; page 9 drawing by John P. Underman, and photograph by Joseph S. Kingsberry, both of the Office of the Chief Engineer, Bureau of Reclamation, Denver Colo.; page 10 photo of mural in the new Interior Building, Washington, D. C., by the late John Steuart Curry; page 11 (top) photos by Wesley Guderian, Herald News photographer, Klamath Falls, Oreg., (bottom) lower left photo by the Bureau of Land Management, United States Department of the Interior, and lower right photo by the National Park Service; page 12, three photos on left panel by the Bureau of Land Management; center bottom photo by the Bureau of Land Management; upper right photo by Frank B. Pomeroy, region I; lower right photo by Ben Glaha; pages 14 and 15 photos by the National Park Service; and pages 16, 17, and 18 photos by the Bonneville Power Administration, U. S. Dept. of the Interior; page 21 cartoon by Tom E. Lawlor, Spokane, Wash.

Reclamation ERA

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Art work by James D. Richardson, Georgie Petty, and Mary Edmondson, Bureau of Reclamation, Washington, D. C.

RECLAMATION'S RECORD

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Wi. 33-34

From June 1902 through June 1946

In Return for Less Than 1 Billion Dollars ($993,056,468) in Federal Funds Invested in Reclamation Projects,

U. S. Docs. 1947-48
Ref.

THE BUREAU OF RECLAMATION HAS

IRRIGATED more than 4,000,000 acres of arid and semiarid lands
and
OPERATED 52 reclamation projects,

WHICH IN TURN *PRODUCED*

Over 4 billion dollars ($4,442,792,686) worth of crops from 1902 to 1945.
Over 400 million dollars ($435,184,395) worth of crops in 1945 alone.
A record yield of $103.72 per acre in 1945.

BUILT . . . . . 31 power plants
GENERATING . . . . . over 13 billion kilowatt-hours (13,172,988,977) annually,

WHICH BROUGHT IN POWER REVENUES

Amounting to nearly 113 million dollars ($112,843,610) from 1909 through 1946.
Over 21 million dollars ($21,158,862) in 1945 alone.
And make the Bureau the largest single power producer in the world.

MADE CONSTRUCTION HISTORY BY CREATING:

World's *Largest* Power Plant	BOULDER (Arizona-Nevada) generating capacity, 1,034,800
World's *Largest* Concrete Dams	GRAND COULEE (Washington) SHASTA (California) BOULDER (Arizona-Nevada)
World's *Largest* Man-made Lake	LAKE MEAD (Arizona-Nevada) capacity of 31,141,755 acre-feet
World's *Longest* Man-made Lake	FRANKLIN D. ROOSEVELT (Washington) 151 miles long
World's *Longest* Irrigation Tunnel	ALVA B. ADAMS (Colorado) 13 miles long

BUILT BY JUNE 30, 1946

15,325 miles of irrigation canals
168 storage and diversion dams
355 tunnels with a combined length of 566,521 feet
219,670 canal structures
3,143 miles of waste water ditches and drains
13,902 bridges
23,816 culverts
6,244 flumes
335 pumping plants
2,516 miles of transmission lines

And Also

Excavated	625,574,739 cubic yards of material
Rock-Poured	34,123,144 cubic yards of concrete
Used	38,870,583 barrels of cement

P. S. *The Bureau is now building the world's highest earth-fill dam, ANDERSON RANCH DAM in Idaho, and the world's longest irrigation canal, the FRIANT-KERN CANAL in California (156 miles long).*

Letters to the Editor

As Maine Goes . . . . .

OCTOBER 21, 1946.

GENTLEMEN: I am happy to say that the magazine RECLAMATION ERA is arriving regularly without very much delay.

I am very much pleased with this and find the RECLAMATION ERA as interesting as it was before the war. I shall be very glad if the Bureau of Reclamation will send me any interesting materials, for I am deeply interested in the teaching of geography and of conservation.

Yours very truly,

ERNEST JACKSON,
Professor, University of Maine,
Orono, Maine.

Canadians Have Weeds, Too . . .

CRESTON, BRITISH COLUMBIA,
CANADA,
SEPTEMBER 26, 1946.

DEAR EDITOR: In your June issue we find an illustrated article entitled "The War Against Weeds," which pertains in particular to weeds in ditches and their eradication.

In our drainage districts we are very much bothered with weeds and therefore much interested in the new method of chemical warfare which you illustrate in the above issue.

Will it be possible through the RECLAMATION ERA to obtain more information on this chemical treatment and the apparatus required? If this is not to be so would you advise where I can address Mr. Balcom, the writer of the article in question?

Thanking you in the above,

Yours very truly,

GUY CONSTABLE,
President, Kootenay Valley,
Associated Drainage Districts.

(Editor's note: Canadian reader Constable's attention has been called to the Bureau of Reclamation's preliminary issue of Control of Weeds on Irrigation Systems, a comprehensive manual listed in our RECLAMATION READING section. Although there is only a limited supply of this publication, a revised version will be issued later for wide distribution.)

On Corralling the Colorado

NOVEMBER 19, 1946.

DEAR MR. MARKWELL: I am deeply indebted to you for your very great kindness in sending to me the RECLAMATION ERA for September, October, and November, which I have perused with the greatest interest and which contain the thrilling and romantic story entitled, "Corralling the Colorado," of which development I had a more or less important part, in a legislative way, covering a 10-year period.

I also enjoyed reading the article by Frank A. Banks on the Columbia River project, with which our Committee on Irrigation and Reclamation had a great deal to do during its initial stages, having visited with the committee on two occasions the projected improvement, especially the Grand Coulee dam site prior to my retirement from Congress, in March 1933.

The photographs are also most interesting, especially the one on page 243 of the November issue taken in the rear of the White House on the 21st day of December 1928, on which date President Coolidge signed the bill making the Colorado improvement possible. It is said to observe that of the six men in the photograph only former Congressman Swing and myself survive.

It is most gratifying that you and your associates, most of whom have come into the service since my retirement from Congress, are enthusiastically and successfully carrying on the reclamation policy initiated nearly a half century ago. No other policy of the Government has accomplished as much toward contributing to the general welfare of the people of the Nation, and created more real wealth and comfort for the masses, from what was theretofore worthless. The history of the accomplishments of the Reclamation Service is a monument to the initiative and industry of farseeing men of courage, and the skill of the engineers and their coworkers. I am proud of having been, in a small way, one of those who participated in the bringing about the great development of the arid West.

Sincerely yours,

ADDISON T. SMITH,
Attorney at Law, 1852 Columbia Road,
Washington, D. C.

(Editor's note: Mr. Smith was formerly chairman of the House Committee on Irrigation and Reclamation.)

So We're Vital!

NOVEMBER 21, 1946.

DEAR EDITOR: We will be only too glad to exchange with your publication, the RECLAMATION ERA, for our magazine, bimonthly, *Public Ownership of Public Utilities.*

We are so happy to again be receiving the ERA. Its new form and style is vital and extremely interesting and inspiring!

Sincerely yours,

ELEANOR SPAETH,
Assistant Secretary, Public Ownership
League of America.

For Your Art Collection

Write to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue. *This does not apply to photographs which carry outside credit lines.**

CONTACT PRINTS, single weight glossy paper, are available at the following prices *only if size of negative permits.* Most Bureau of Reclamation negatives are 8 by 10 inches.

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30 by 40 inches double weight mat	8.00
	Per sq. ft.
Over 30 by 40 inches double weight mat	$0.85

Recent Project Maps

Published by the Bureau of Reclamation

Western half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 by 20 inches, FREE.

Orland project, California. Map No. 45–45 (supersedes No. 21880). Blue, green, and black. Size 8 by 10½ inches, price 10 cents.

Grand Valley project, Colorado. Map No. 45–40 (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 by 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52 (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 by 20 inches, price 25 cents.

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

(Distributed from the Bureau of Reclamation Office, Washington 25, D. C.)

Boulder Dam	5 reels	(silent)
Boulder Dam	4 reels	(sound)
Reclamation in the Arid West	1 reel	(sound)
Fundamentals of Irrigation	3 reels	(sound)
Irrigated Pastures (Kodachrome)	2 reels	(sound)
Fighting Weeds (Kodachrome)	3 reels	(sound)
Measurement of Water (Kodachrome)	3 reels	(sound)

*Note.—In ordering maps or photographs, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C.

I Finally Struck It Rich

by C' deVERE FAIRCHILD

Reclamation Farmer, Yakima Valley, Wash.

The Land of the Midnight Sun has been an emotional inspiration to writers of prose and poetry for many decades.

To me—one who spent several years in the frozen North during the Klondike gold rush—the green trees, the fertile fields, and the homes of the Yakima Valley in eastern Washington, while much less spectacular, are far more inspiring. Let me tell you why.

The world was electrified by the discovery of gold in the Klondike, and the mad rush that resulted was a natural reaction to the lure of the Yukon. In the year of 1898 I stood for the first time on Gold Hill, a portion of the glacial drift which had transformed gold bearing quartz ledges into the placer form of nuggets and gold dust. These, deposited in the various pay-streaks, made the Klondike famous.

As I gazed upon the scene, my imagination carried me back into the ages of antiquity when the mighty glacier was alive, and then through the periods of time when the musk ox and the mastodon grazed the area.

At last I had reached the end of the Yukon trail. It was thrilling to see the cluster of log cabins on each 500-foot claim along Eldorado and Bonanza Creeks, and the winding defile among the abrupt sloping hills. The Eldorado flowed into the Bonanza at the foot of Gold Hill. Twelve miles downstream, the latter creek emptied into the Klondike River, which in turn, 2 miles below, ran into the Yukon. At the confluence was situated the city of Dawson.

I was thrilled by the knowledge that 90 feet below where I stood, miners were thawing the frozen pay streak and "rocking" the pay dirt. I felt well rewarded for the laborious packing over Chilkoot Pass, the backaches from "whip-sawing" on the shores of Lake Lindeman, the nervous strain of "shooting" Miles Canyon, White Horse, and Five Finger Rapids, and for the physical monotony of rowing a boat 600 miles.

Forty-eight years later, in the year 1946, I stood on one of the scenic high points overlooking the Yakima Valley. Hundreds of homes were visible. The orchards and irrigated fields in their regularity of alinement exemplified human accomplishment and it was an inspiration to know that the highly productive, farm-studded areas below the canal had been transformed from sagebrush, such as I could see above the canal, entirely through man's own endeavor.

As I visualize the Yakima Valley of today, having owned and operated orchards for 34 years without a crop failure, I find social and economic comfort in contrasting it with the 5 years which I spent in the Klon-

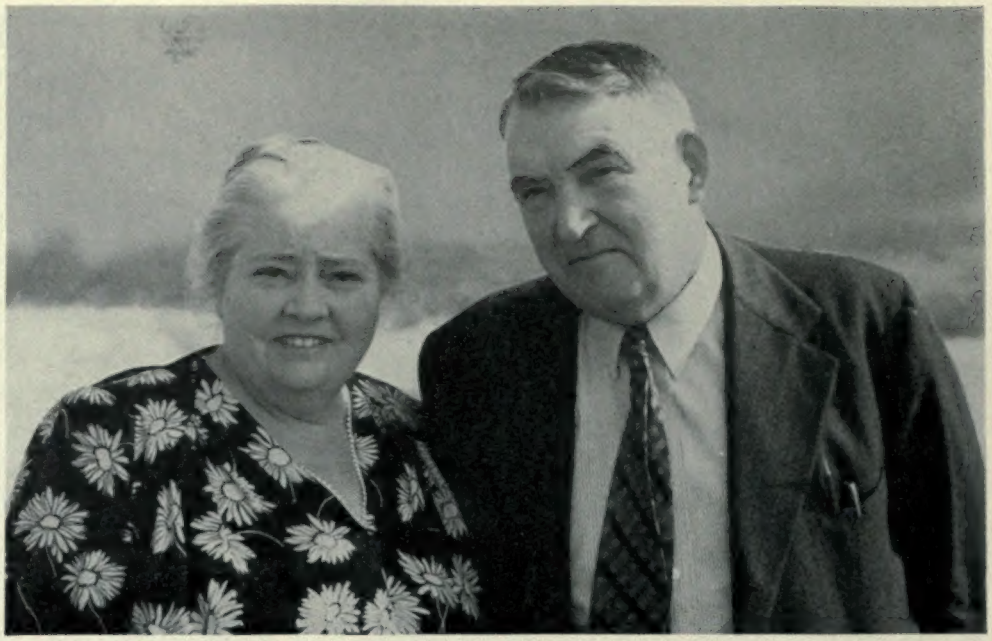
dike on Gold Hill, Bonanza Creek, Cheechako Hill, Adams Hill, Dominion Creek, and Magnet Gulch.

In comparing the economic worth of the Klondike glacial drift with the Yakima River I want to emphasize that there was but one "pay-streak" deposited by the glacier, and when that was mined the final chapter had been written, whereas the Yakima River and its tributaries every year deposited a "pay-streak" over the 400,000 acres of the Yakima Valley and in all probability they will continue to do so for centuries to come.

Terming the agricultural and horticultural activities of the Yakima Valley a "pay-streak" can easily be justified. I submit as proof the accompanying table showing factual data of crop values of a small portion of the valley; namely, the Tieton Division of the Yakima Federal Reclamation project, covering a period of 34 years, from 1912 to 1945, inclusive. It shows how much an acre-foot of water is worth in crops produced. The figure is most impressive.

The Tieton Division, an area of approximately 25,000 acres, devoted largely to fruit production, was completed by the Bureau of Reclamation in 1911, and water was available to the entire division in 1912.

In the table, for the sake of brevity and to afford a simplified analysis of the economic aspect of the area involved, I have called the first 4 years of agricultural activity a development period, and listed the remaining 30 years in three columns, each covering a decade of operation. The summary shows the total and average values of crops per acre and per acre-foot, and also includes separate data for the year of 1945.



Striking it rich again, here is Mr. Fairchild and his attractive wife who helped him make a success of the farm

The table reveals some startling facts. It shows that the average acre-foot of water of the 2,388,775 acre-feet applied to the land over the 34-year period was worth $55.24 in crops. Saying it another way, every second-foot of water for 24 hours has brought crop returns averaging $109.56. In 1945, with wartime prices in effect, the average value in crops of every per-acre foot of water actually delivered to the land skyrocketed to a record peak of $255.70.

Every year of the 34-year period the average annual crop returns of $3,880,771 have exceeded the total construction cost of the Tieton Division by $418,291.54.

(*Continued on page 7*)

VALUE OF WATER ON TIETON DIVISION—YAKIMA PROJECT

	Development period	Operation period			Total—34 years	One year
	1912–15	1916–25	1926–35	1936–45	1912–45	1945
Average number of acres	19,090	27,097	26,694	25,084	25,444	24,679
Average acre-feet diversion	59,243	92,437	92,116	95,888	89,451	98,717
Average acre-feet delivered to land	40,115	66,955	75,733	80,144	70,258	82,046
Total crop value	$1,631,968	$21,323,343	$26,032,663	$82,958,245	$131,946,219	$20,979,434
Average crop value per year	$407,992	$2,132,334	$2,603,266	$8,295,824	$3,880,771	.....
Average crop value per acre	$21.37	$78.69	$97.52	$330.73	$152.52	$850.09
Average crop value per acre-foot	$10.17	$31.85	$34.37	$103.51	$55.24	$255.70

Weed Trap

Mustard and thistle, when forced into a detour, never finish their ride

by THEODORE NELSON

Irrigation Manager, Black Canyon Unit, Boise Project, Region 1, Boise, Idaho

"I am trapped," said the Russian thistle to the Jim Hill mustard. And sure enough he was.

Bureau of Reclamation operation and maintenance employees of the Black Canyon unit of the Boise project in southwestern Idaho again this past summer got a record yield from their traps. Only it was not animals or birds for which the carefully planned snares were set. It was weeds—mustard and Russian thistle which are so often seen floating along canals in the area.

Literally tons of these weeds were removed from Black Canyon canals by specially designed weed traps. These trapping operations have paid off by removing the cause of breaks and structure failures—weeds clogging the canals.

Several years ago, after a heavy windstorm, the Black Canyon canals carried mustard and thistle so thick that the only water to be seen was along the edges where stems pushed the heads back into the stream.

Today only a few of the floating weeds can be seen in the canals and it is a better-than-even bet that they too will be piled high on the floor of one of the traps before long. A poor weed just has not a chance any more.

The weed trap shown in the diagram has proved an effective and economical way of removing floating weeds from Black Canyon canals. It was designed by Bureau operation and maintenance personnel and probably can be adapted for use in other areas in which floating weeds constitute a real threat to efficient irrigation.

On the Black Canyon unit the main canal runs for about 30 miles, contouring low hills and plateau land, which is covered mostly with cheat grass, mustard, and Russian thistle, plus a few sagebrush stumps and an occasional patch of unmolested sage.

Two secondary canals take off from the main canal and the three together form a complete circle around nearly 50,000 acres of grazing land, covered with a growth similar to that along the main canal. The location of these large areas of mustard and thistle make it certain that no matter which way the wind blows, some growth will land in one of the canals—often in all of them.

The danger of clogging checks and syphons and an ever-decreasing water volume made it imperative that something be done to remove floating weeds from these canals before a jam caused a serious break. To shut off the water would have been an easy answer, except that the damage would have been done before the "drop" reached the danger points.

First attempts to design a structure to overcome this hazard consisted of building floating booms at an angle across the channel where there was no bank on the upper side and this back-up would provide room for weed storage. A schedule was arranged calling for a truck with three men, Jackson fork, cable, lights, pitchforks, and miscellaneous equipment to go to each boom whenever the wind blew hard, regardless of the time of day or night.

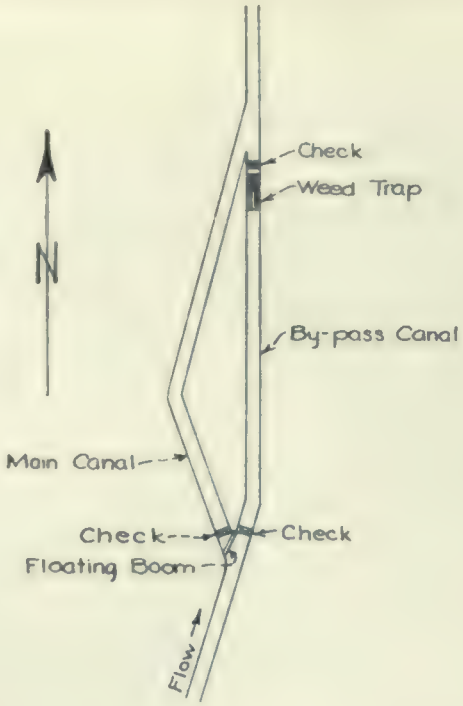
Key men were left free to patrol vital structures and the intervening ditch areas. Because the weeds were wet it was necessary to use a considerable quantity of fuel oil to keep a fire going and thus eliminate the necessity of stacking them.

Despite the efforts of the entire operation and maintenance crew, which, for several years, was kept on the alert during wind storms, a weed jam plugged a syphon and took out one of the booms. It was apparent that a more elaborate and more efficient weed trap was needed, and plans were drawn up for the present structures.

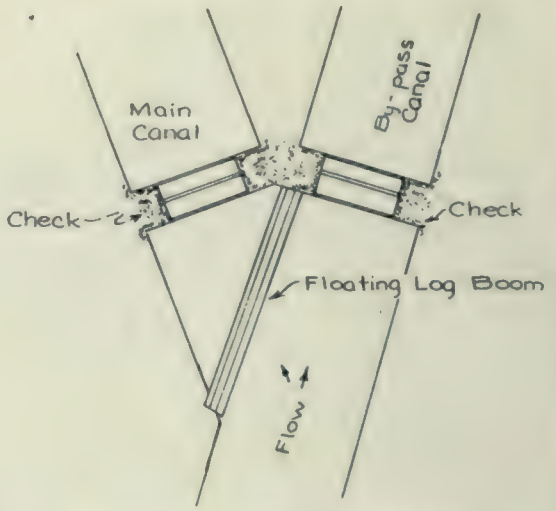
On one of the secondary canals there was a stretch on the upper side with very little bank and enough low ground to accommodate a pond 100 feet wide by 400 feet long. This location had the advantage of being below the areas which supplied most of the weeds—yet far enough upstream to have sufficient canal width for carrying capacity.

A bend in the main canal just above the low ground permitted construction of an auxiliary (or bypass) canal. The inlet was in a straight line with a 360-foot section of the main canal. This was desirable because floating material could be diverted straight into the auxiliary canal.

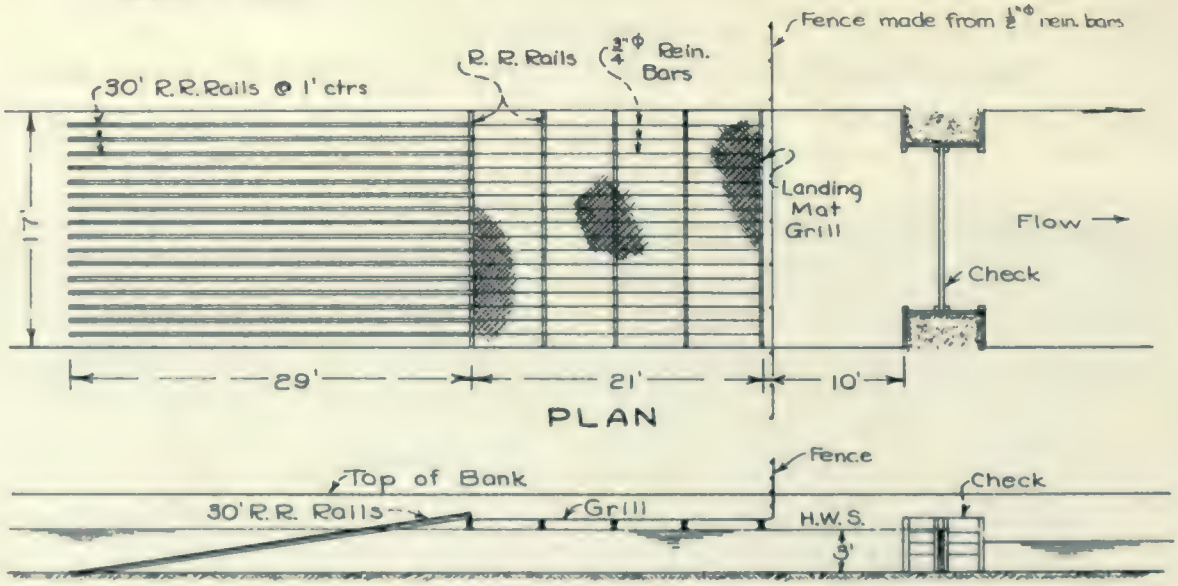
Beyond about 275 feet of normal size inlet throat, the new auxiliary section was widened to about 100 feet for a distance of 200 feet and then tapered into another 125 foot stretch of normal width section and brought back into the old canal on an angle which would tend to merge the two streams without turbulence and back wash.



GENERAL PLAN
Scale: 1" = 200'



INLET CHECK DETAILS



LONGITUDINAL SECTION

WEED TRAP DETAILS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PAYETTE DIV. - BOISE PROJ. - IDAHO

WEED TRAP

D-LINE CANAL ~ M.P. 23

DRAWN: R.W.R.

NOTUS, IDAHO ~ 9-3-46

As the weeds pile up, they are removed from the racks.

Check structures were placed in the old canal, and at the head and outlet of the auxiliary canal. Directly above the outlet check and in the normal-width section, a sloping rack of 30-foot railroad rails was placed with the flat bottoms up. The lower ends were set on mud sills and held in place by spacers far enough below canal grade to keep low floating weeds from collecting on the ends of the rails.

The top of the slope was supported by a cross rail holding the upper end of the sloping rails about 4 feet above canal grade or 1 foot above high-water line. With the aid of the diverting boom and by proper regulation of the bypassing water, it was possible to lead weeds into the pond and onto the weed rack without manual labor. This system had the advantage of keeping the old channel open in case of a complete tie-up on the rack.

The arrangement was a big improvement over anything tried previously, but two problems immediately presented themselves. First, there was no storage space for weeds on the rack and the wet weeds could not be burned immediately, but had to be forked from rack to ditchbank. Secondly, the wide pond soon filled up with silt, stopping weeds before they reached the rack.

To provide storage space for the weeds, a 15-foot grill was built, leveling off from the end of the sloping rails and covering the entire width of the canal from 12 to 18 inches above water level. The grill was supported by four cross rails upon which were laid ¾-inch reinforcing steel placed at 1-foot intervals paralleling the canal. The grill itself was made of 5- by 10-foot steel airplane runway mats.

This permitted immediate drainage and eliminated considerable handling since many of the weeds moved up on the racks and spilled over onto the grill. The water level at the rack, regulated by the check immediately below, to a great extent determined the amount of forking necessary.

A few bars of reinforcing steel wired together were made into a fence at the downstream end of the grill, thus keeping weeds from rolling off the grill and back into the ditch. To take care of heavy runs, the bank was trimmed down and a Jackson fork used to get weeds from rack to ditchbank.

To eliminate the difficulty of weeds piling up on silt bars in the pond, the channel was cleaned and narrowed to normal ditch width. Thus, the two basic problems of the original design were overcome.

The bypass and steel rack arrangement permitted a night patrolman to handle fairly heavy weed runs without additional help. It also provided storage for all weeds on lighter runs without the need for manpower, making it possible for the day crew to take care of them.

Similar structures were constructed on other canals. They have removed tons of floating weeds which otherwise would have choked headgates and structures. The installations also have saved a great many man-hours and have not required much maintenance.

A good weed trap is an imperative aid for an emergency weed condition. In the long run, however, a program to control these weeds before they reach canals should, of course, be initiated. On the Black Canyon unit it has been found that range fire control, proper grazing, and range and canal bank seeding have all been outstanding in producing results along this line.

I Finally Struck It Rich

(*Continued from page 4*)

A careful study of the table shows that during the 34 years of operation each and every acre of the Tieton Division which was irrigated throughout the period produced crops valued at $5,185. In other terms, every 20-acre tract produced $103,700 in crops.

While the gross crop returns from Tieton Division admittedly are very high compared with average returns from Bureau projects in the 17 Western States, the figures nevertheless provide an impressive indication of the true value of water in western streams and of what the Nation is wasting in dollars and cents by not fully utilizing the run-off available.

Figures on production in the entire Yakima Valley for the three years of 1943, 1944, and 1945 also provide indisputable evidence as to the value of water as compared with gold in the Klondike. During the 3-year period the valley raised crops valued at $320,193,500—an amount greatly in excess of the Klondike production in its entire lifetime. During the last 20 years, from 1926 to 1945, inclusive, the productive valuation of the Yakima Valley was $900,000,000, or more than three times the total Klondike production.

Since we know that these irrigated areas will continue to produce through the centuries to come, it must be obvious to even the most casual observer that the recurring "pay-streak" which is created in irrigated land by making available flood waters stored in Bureau of Reclamation reservoirs has and will continue to yield great wealth in the Yakima Valley, compared to which the gold of the Klondike is insignificant.

In retrospect, I remember sitting in my cabin on No. 8, below Discovery on Bonanza Creek and yearning for a fresh tomato, for an ear of sweet corn, and other delicacies from the "outside." As I looked upon the shelf where a considerable quantity of nuggets and gold dust was contained in some emptied "Extract of Beef" jars, I soliloquized, "Yes; you could sit here and look at all the gold in the Klondike and starve to death."

Now, as I view the Yakima River, the even flow of which is maintained by the Federal storage dams at Lake Keechelus, Lake Kachess, and Lake Cle Elum, I am overwhelmed by the thought of what a blessing irrigation is to the world. The wealth being produced from storing run-off of streams is in such a form that it directly assists in saving human beings from starvation. As I watch the water rippling on its course to the thirsty acres below I realize that water is the most essential item to the very existence of man and that controlled water, judiciously applied to fertile soil in a favorable climate, is the most valuable commodity on the face of the earth.

My Year in the United States

American Customs and Engineering Science as They Appear to a Chinese Trainee

By CHUNG-YU PAN

Assistant Engineer, National Resources Commission of China

First, no more chop suey or chow mein, please!

Perhaps you have seen my fellow engineers when they have visited your irrigation projects during the past year. We have wandered far and wide over these 17 Western States studying American methods and learning a little about that famous American "know-how." It has been a real pleasure for us to chat with so many western irrigation farmers. And our godfathers, the Bureau of Reclamation, under whose guidance we are training, have made sure we have not missed anything.

But to get back to that chop suey business. We don't like it. As for those big, thick, juicy steaks that usually make an American's eyes pop out—well, they appear to be just an unattractive chunk of beef. On the other hand, I adore the American hamburger. It is my belief that some of those adjectives your Hollywood likes to toss around, like "colossal" and "stupendous," might be better applied to the delectable and delicious hamburger. Our second ranking favorite in American dishes is pie a la mode. It may surprise you to know that when we came to this country, we soon learned to steer clear of Chinese restaurants. We prefer the good old American hamburger joint.

Our year of study in the United States has been wonderful. It was my biggest break when, along with a thousand other young Chinese engineers, I passed a competitive examination and was selected by the Chinese Government to visit the United States for a year of practical, on-the-job training. The State Department has sponsored our visit with all costs borne by our own government.

Our group left China in April of 1945. We flew over "the hump," made famous by American flyers, to Calcutta, India. Here we boarded a United States Coast Guard transport that took us all the way to the east coast of the United States via the Indian Ocean, the Red and Mediterranean Seas, and the Atlantic Ocean. Our ship took the wartime zigzag course for a journey that lasted one hot and monotonous month. I still remember the slow-moving, never-ending chow line and the not-much-to-our-liking KP duties.

Washington, D. C., was our first stopover. Here we had the opportunity to see democracy in action by witnessing heated debates in both the Senate and the House. We greatly admired the beautiful and dignified government buildings, monuments, and memorials. We enjoyed the privilege of visiting the famous Library of Congress. It was then arranged for a group of 19 Chinese engineers to go to Denver to study with the Bureau of Reclamation, the world-famous organization which, in a very short period of a few years, achieved such engineering marvels as Boulder, Grand Coulee, and Shasta Dams. The success of the Bureau in these spectacular and revolutionary dam-building projects has certainly changed the viewpoint of the entire engineering world and has started a new era of engineering yardsticks and economy. Engineers the world over, fascinated by the work of the Bureau, have flocked to the United States for knowledge and advice. It was indeed our great fortune to be able to study in this international center of advanced engineering.

My first impression was of a large but well-geared organization. It has the combined advantage of a centralized design and construction office under our good friend, Chief Engineer Walker R. Young, and the decentralized administration of projects by seven regional directors. The chief engineer's office in Denver not only has a concentration of expert technical personnel but the assurance of the highest type of engineering work on all projects. On the other hand, the regional and project supervision avoids the inefficiency of remote, centralized supervision.

During my 1-year stay in the chief engineer's office, I have been greatly impressed by the detailed specialization of work, each under the immediate supervision of a top-flight engineer, usually a leading authority in his field. This facilitates the training of specialists, which in turn assures greater efficiency and enables research to be carried on under competent guidance. We in China, due to a great lack of technical men, are usually called upon to tackle any odd job in the profession. There is, however, a realization of this fact in Chinese engineering circles, with the result that we were instructed to specialize in one branch of engineering. That is what we have been endeavoring to do.

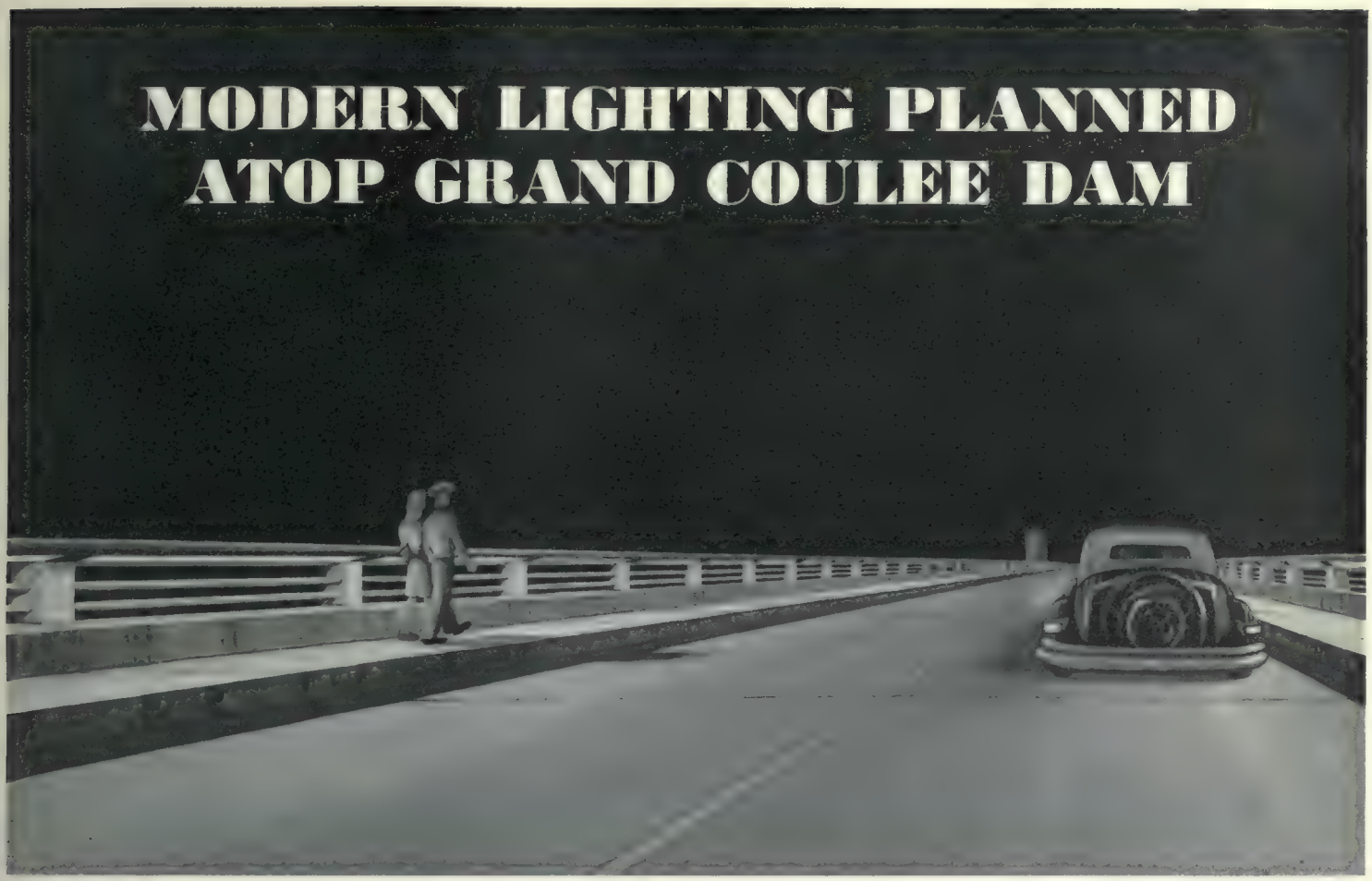
In addition to our studies in Denver, we also have been given the opportunity to see many of America's reclamation projects in a series of inspection tours throughout the Western States last winter. We saw miracle after miracle, where treacherous rivers were harnessed and barren deserts were turned into beautiful meadows. The green pastures and crops under cultivation, in contrast to the neighboring sagebrush, appeared like mirages in the desert. This at once reminded us of the great amount of work that should be done by us in our own China. We have a great wealth of resources, and it is our immediate responsibility to see that these are developed. The great results achieved in the United States should give us the inspiration and courage to follow through.

Our year in the United States has been most exciting and beneficial. We have been kept so busy we have had little opportunity to feel homesick.

We have learned to understand and respect the American people and their way of living. We have found that America today is not a happy-go-lucky nation as glamorized by Hollywood but a country with its feet on the ground as a result of a hundred and seventy years of pioneering and hard work. The present high standard of living is not merely a matter of luck but the justifiable return to a great and courageous people. God only helps those who help themselves.

I am grateful for the invitation to write this article for the RECLAMATION ERA because it affords me the opportunity to thank the irrigation farmers of the West and the American people for their helpfulness on so many occasions. We are especially thankful to the Bureau of Reclamation, their officials, engineers, and employees in all offices for their very sincere cooperation and for the friendship they have generously and graciously extended to us on every occasion.

MODERN LIGHTING PLANNED ATOP GRAND COULEE DAM



What are believed to be the world's longest continuous lighted railings will be installed atop Grand Coulee Dam, man's largest concrete structure. More than 7,800 feet of fluorescent tubing will transform the 30-foot, top-of-the-dam roadway into a ribbon of glareless light.

The tubular lamps, 6 and 8 feet in length, will be placed in the semicircular top rail of glistening metal. Streamlined secondary railings will be placed below. Specifications call for aluminum, stainless steel, or monel metal.

The especially designed, dual-purpose crest railings, which are to replace temporary wooden buildings, will provide sturdy protection and adequate lighting without sacrificing beauty of line. And they will afford more than 40 percent unobstructed vision to motorists, in contrast with the frequently used solid rails or parapets which confine the view largely to the roadway.

Rectangular metal posts will be spaced 10 feet apart across the dam's crest. Intermediate horizontal rails, ovaliform in cross section, will be sloped so that their normal axes intersect at the approximate eye level of motorists driving across the dam. The semicylindrical top rail, also of shining metal, will house reflectors with flat refracting lenses, in addition to the tubular lighting units. A uniform and practically shadowless flood of light will blanket the entire roadway. The light will be below the eye level of both motorists and pedestrians. Advantages of the design adopted for the Grand Coulee Dam were demonstrated in full-scale laboratory tests.

There will be approximately 3,900 feet of lighted railing on the downstream side of the dam. This is less than the length of the dam's crest (4,173 feet), principally because four elevator towers eliminate the need for approximately 160 feet of railing. The lighted top railing on the upstream side will be approximately 10 feet shorter than that on the downstream side because it will end at the "wing" dam for the pumping plant, at the west abutment.

Here is the model of the continuous lighted railings planned for Grand Coulee Dam.

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Homesteading—Then and Now

From a mural by the late John Stewart Curry.

by Paul D. Olejar, *Bureau of Reclamation, Washington, D. C.*

Galloping ghosts of the Cherokee Rush and other races for homesteads fondly remembered in folklore and movie fare, might well stop to gape at the 1947 version of land settlement now under way in the West. The difference is enough to send the spirit of any scheming "sooner" of 1893 screaming back to the strip.

The 1947 version is positively calm. Instead of the turmoil, the shooting, knifing, and trickery that accompanied the wild dash of plunging horsemen, careening wagons and buggies, and foot-sore runners for free land, there is a quiet orderliness. Reclamation project homesteaders most likely to succeed are selected scientifically. The names of qualified applicants are turned over by local examining boards to gentle Lady Luck who still rules. A lottery bowl governs an orderly, democratic selection of farm winners.

This fall, the passing of the old ways on which the "sooner" thrived was completed. The occasion was the Bureau of Reclamation's opening of the Tule Lake division of the Klamath project on the Oregon-California border—about as far west as a homesteader can go. This was the first postwar opening of public lands from a small group of reclamation farms, out of the several thousand which are to be irrigated, wrested from dry wastes, and offered to homesteaders in the next few years. And while on an acreage basis this first of several settlement opportunities to be created in the near future is small, it illustrates how great is the change from the early land rushes. ***While three times as many persons tried to settle in the Cherokee strip in 1893 as the available land could accommodate, there were 30 times as many applicants as there were available farms at Klamath.*** The pressure is still there—but the atmosphere is different. Science and democratic selection have changed the stampede of the 1890's into an unspectacular but equitable process of settlement.

Veterans of World War II were given first opportunity to take up the available lands opened by the irrigation works built in the area. Prospective entrymen had to have their applications in by September 15. They furnished evidences of character, farming experience, and resources (either in the form of cash or farm machinery or livestock) deemed sufficient by the local project board to carry them through. Names of the selected settlers were drawn by lot from among the list of qualified applicants—and in that drawing was perhaps the only real link to the haphazard settlements of the past in which luck played so important a part.

The settler in Oklahoma sometimes found that his land was only dust—like that which caked his weary figure after his breathless dash. But the Tule Lake lands were first analyzed by experts to make certain they would make good farms, and not until they were classified as farm lands, was public notice of their opening given.

Some of these lands have already been farmed, although without an adequate supply of water. All have been examined by agricultural experts and deemed economically suitable for tillage.

The modern settler will know he is going onto land which is capable of producing a good living if he works it properly. And the Government knows that the man who is going onto the land it is giving away is qualified to make a success of his enterprise.

Preference for veterans, stipulated by the Congress for these reclamation areas, is the continuation of a policy of making public lands available to war veterans that goes back to ***Revolutionary War*** days. It opened up the lands in the Ohio Valley and other areas west of the original colonies. It pushed settlement and empire into the wilderness. It created new States. And it served many millions of people in all walks of life. Capt. Abraham Lincoln received 120 acres from the Government for his services in the ***Black Hawk War.*** Capt. Robert E. Lee, who later led the Confederate Armies, and Ulysses S. Grant, who defeated him, received land for services in the ***War with Mexico.*** Other historic gentlemen shared in the Government's bounty. Among these was Lafayette, who received 23,000 acres, including what is now the city of Tallahassee, Fla.

To induce enlistments in the ***Continental Army,*** in 1776 a bounty of land was offered, with acreage ranging from 1,100 for a general, down to 500 for a colonel and 100 for a private. That differential does not hold today. ***A buck private has the same chance as the highest "brass" in our 1946 democracy.***

In 1796, Congress set apart 2,500,000 acres in what is now the State of Ohio to handle these bounties. Later, ***Revolutionary War*** veterans could settle in Indiana, Illinois, and remaining portions of Ohio. For service in the ***War of 1812,*** 6,000,000 acres were set aside in Michigan, Illinois, and Louisiana Territories—in the latter territory, the lands were in what is now Arkansas. Only enlisted men and noncommissioned officers were permitted to share in this bounty. Officers in that war were not included until 1850. More than 5,000,000 of this acreage was taken up by

Stacks of application blanks for the board to classify.

That fishbowl again! *This time a lucky number gets you a farm.*

servicemen. There were 29,000 bounty land warrants issued. ***Campaigns against the Indians*** and the ***Mexican War*** offered other opportunities for providing bounty lands to soldiers.

The bulk of public domain lands was sold by the Government all during these years. More than 200,000,000 acres were disposed of in this manner, and the cash received helped to meet Government expenses. The military bounty land warrants disposed of an additional 60,000,000 acres.

Between 1847 and 1855 Congress enacted a series of laws which liberalized and extended bounty-land provisions. By 1855, a person who had served only 14 days in the militia or United States forces, or engaged in a single battle, could receive land. If he preferred, he could accept Treasury scrip instead. Widows or children of veterans who had died could also apply.

About this time opposition to this system became articulate. The original intent to reward for military service, supply land for establishment of homes by veterans, and settle the frontier for defensive purposes, was altered in part by the new liberalizing acts, and in part by the unwillingness or inability of many veterans to settle on the land. The act of 1852 made all bounty-land warrants assignable. This resulted in widespread speculation in land warrants.

The Homestead Act of 1862 marked a new era in pioneering and homesteading. It was heavily responsible for the sweep westward of settlement to the Pacific. In the course of time, 275,000,000 acres were transferred to settlers under its basic provisions.

Daniel Freeman, the first homesteader under this act, was a Federal soldier who staked out a claim near Beatrice, Nebr., while on leave. He planned to file his claim when the act became operative January 1, 1863. Fortunately, he was on military detail in Brownville, Nebr., the seat of a Government land office, on December 31, 1862, when he received orders to proceed to St. Louis the next morning. He hopped on his horse and rode posthaste to a dance being held that night by prospective settlers, breathlessly sought out the assistant register, grabbed him from the dance floor, and persuaded him to permit the filing of his claim shortly after midnight. The papers were made out and Freeman left the next morning for St. Louis with homestead entry No. 1. After the war he returned and began residence on his claim. The farm now is a national monument.

After Freeman came hundreds of thousands more settlers. Among the requirements for "proving up" under the homestead law was that a "habitable dwelling" should be on the land at the time of proof. Investigations turned up a homesteader

It was "veteran's preference" even then.

The first homesteader took a midnight ride.

Land rush—old style, Yankton, S. Dak., 1904.

Happy vets who got T

Mushroom town in the early days.

who proudly pointed to a bird house on his claim. Habitable it was—and tradition has it that he kept his claim, as nothing was found in the law stating that the dwellings had to be habitable for humans. Other "habitable dwellings" for that particular climate were caves, sod huts, poles with extremely remote resemblance to roofs erected over them, and shaky lean-tos constructed of sagebrush and weeds which disappeared when the wind was high. ***These helter-skelter excuses for homes in past homesteading projects present a graphic and amusing contrast to present-day housing facilities.***

The homestead law was steadily liberalized until in 1916 a homesteader was allowed 640 acres and required to live on the land only 7 months in each of 3 years to obtain a title. While this system had discontinued bounty lands for military service, veterans were given special attention. In 1872, Union soldiers of the Civil War were allowed to credit military service in

Morning of the opening, Lawton, Okla., 1901.

When a tr

s by lease last spring.

determining the time required to perfect a homestead entry and this privilege was later extended to veterans of other wars, including World War I.

Some Indian areas were opened to homesteading as white settlements pushed forward, and Indian land needs decreased. The most important of these were in Oklahoma Territory. The principal requirement was that a prospective homesteader be a citizen of the United States or have declared his intention to become one. Spectacular scenes were common.

The Cherokee rush of 1893 was typical. To prevent parties with no rights from entering the lands, a registration system was adopted. Nine booths were erected for this opening and 45 clerks were detailed to duty. In 9 days more than 115,000 persons registered on the borders of the new lands, some intending to become farmers, others having their eyes on the lots in the

(Continued on page 24)

Home Again—a typical homesteading scene enacted by veteran Melford L. Woodword, of the Deschutes project, Oreg.

a home.

Modern residence near Tulelake, Calif.

WINTER IN THE WILDERNESS

OUR NATIONAL PARK SYSTEM—AND WINTER SPORTS THEREIN

by Isabelle F. Story
Editor in Chief, National Park Service

KING OF THE WINTER SPORTS—*On the beautiful Yosemite ski slopes in California.*

WHEN the National Park Service was created as a separate agency of the Department of the Interior, the Reclamation Service, as it was then known, had been in existence for about 14 years. As a big brother to the fledgling Park Service, it was especially helpful in furnishing photographs. This was a much-needed service which called public attention to the national parks, what they had to offer visitors, and their place in the national scene. Remember, this was before the days of wide-spread automobile use, before radio came into your homes.

Today, with both Bureaus well matured —the National Park Service this summer celebrated its thirtieth anniversary—the two agencies work more closely together than ever. As great lakes are formed in connection with power and irrigation projects, problems of recreational use arise, calling for careful planning and development. For, in the short span of 30 years, and particularly since the early thirties, the Park Service has become an acknowledged leader in the field of recreational planning.

In the early days of these two Federal Bureaus, national parks and monuments were located primarily in the West, many of them neighbors of reclamation projects. The western parks probably still are best known to the fortunate dwellers on reclamation areas. The scope of the National Park Service has grown, however, until its areas reach from the Atlantic to the Pacific Ocean; from the northern international boundary to the Mexican border; and up into Alaska and out into the Pacific to the Hawaiian Islands. In all, it includes 168 areas, among them the most spectacular scenery, stupendous mountain massings, interest-compelling scientific phenomena involved in world making and remaking. There are also significant historic areas connected with the history of man in what is now the United States from the time of the simple dwellers in caves and pits, through the development of extensive communal prehistoric dwellings on to modern times. Because of their variety, protection of the park areas, their maintenance and development for public use, and interpretation to the visitor, involve a working knowledge of nearly all the known sciences and techniques, from the study of fossils to the latest advances in radio communication.

In the first full travel year following the ending of the shooting war, with travel conditions and accommodations still an uncertain quantity, the number of visitors exceeded slightly the previous all-time high of 1941, reaching approximately 21,700,000. It is expected that during this winter those parks accessible to travel will draw many visitors, and attention is now being given to providing for winter sport use.

Most of the mountainous parks and all those of the North meet the requirements of the working skier. Those who ski for the fun of it may have to look around a bit for the right combination of topography, climate, and amount and type of snowfall. Here is a bird's-eye view of the wilderness parks in winter—their natural features, their accommodations, and their use.

The forested wilderness parks are unusually beautiful and inspiring in their winter setting of snow and ice. Mountains and valleys are transfigured; snow-laden forests offer striking spectacles. The opportunities for winter sports are superb and exhilarating alike to participant and to spectator. Outstanding among the accessible areas of heavy snows are Yosemite, Sequoia, and Lassen Volcanic National Parks in California; Mount Rainier National Park in Washington; Crater Lake National Park in Oregon; and Rocky Mountain National Park in Colorado. In them, facilities for snow sports vary almost as widely as does the scenery itself.

Yosemite Valley, in the park of the same name, has a breath-taking, dreamlike quality when cloaked in fresh snows. In the High Sierra above, the snows point up the beauty of Half Dome and other massive peaks. Yosemite Falls builds up a cone of ice. In the valley itself are the living accommodations and facilities for the milder sports—the skating rink, the toboggan slides, the horse-drawn sleighs and cutters, and the picturesque dog teams. The skiing center is high above the valley, at Badger Pass, only a short distance by motor. The broad terrace of the Ski Lodge there affords an excellent vantage point to watch winter activities. Beyond are the skiers on the main hill and on the "nursery" slopes. On the terrace itself, basking in the sun, one may lunch, wax skis, or just sit. The mechanical lift, called the "up-ski," takes skiers to a point where many of the runs start, nearly 1,000 feet above the Ski Lodge. A little way from Badger Pass is the Ostrander Lake ski hut, for the use of more advanced skiers. Some of the finest cross-country skiing to be had anywhere is in the Yosemite backcountry, but this is for experts only. Last winter nearly 82,000 persons visited Badger Pass, and during the skiing season which lasted from December to April approximately 106,000 visitors came to the park. It is hoped that the Ahwahnee Hotel, recently returned from duty as a Navy hospital, may be rehabilitated in time for the famous holiday Bracebridge dinner, an annual prewar event.

In Sequoia National Park, and the Grant Grove section of the Kings Canyon National Park, the giant sequoias are inspiring in their ermine-white mantles. Some of them have supported the snows for two or three thousand winters, possibly more. In keeping with the dignity of the big trees and the simplicity of developments in these two parks, winter sports are held to an informal basis. It is expected that overnight accommodations will be available again this winter, as before the war, and that family parties will continue to take advantage of the opportunities for skating, skiing, and tobogganing.

At Lassen Volvanic National Park, is our most recently active volcano (Lassen Peak, ceased its last eruption in 1921). With its fumaroles and hot springs, it is a queer quirk of nature that there is a longer skiing season there than at any other area in the United States. The terrain and snow conditions for skiing are, in the opinion of leading skiers at home and abroad, among the finest the world has to offer. Occasionally snow conditions permit a midsummer ski tournament. The problem of winter use is a comparatively simple one at Lassen, as much of the area developed for winter sports lies outside park boundaries. So do the overnight accommodations.

Crater Lake in winter is a fantasy of snow spendor. The great evergreens, bearing huge loads of snow, and the white-spattered colorful volcanic walls, frame strikingly the deep blue of the jewel-like lake. The roads into the park from the south and west are usually kept open with snowplows so that visitors may enjoy the view and that skiers may enjoy the slopes, steep and gradual, that afford skiing at various speeds. Simple meals and limited overnight accommodations, also emergency automobile service, probably will be provided this winter at park headquarters, as they were in prewar winters.

Mount Rainier National Park is another volcanic area. The great peak around which it centers—"The Mountain" to that portion of the Northwest—always is wrapped in heavy snows, and sustains an enormous single-peak glacier system that sends icy tentacles down into the forests below. Yet the hot breath of the dying volcano breaks through the summit snows. Paradise Valley in this park has been a popular winter center for several decades, and it is hoped that arrangements may be made to use it again this winter. Nature works against such use, as this high mountain valley becomes inaccessible without constant snowplow use when heavy snows come. Sometimes the drifts reach to the gables of Paradise Inn, and in mid-winter a tunnel must be cut through the snows to reach its door.

WINTER WONDERLAND—*Crater Lake National Park, Oreg.*

FINAL CHECK—*By skiers at Badger Pass Lodge, Calif., just before hitting the trail.*

SNOW SLUMBER—*Mount Rainier National Park, Wash.*

PUBLIC POWER and SMALL BUSINESS

WHAT THE AVAILABILITY OF LOW-COST PUBLIC POWER HAS MEANT TO SMALL BUSINESS AND INDUSTRY

by FREDERICK P. ARPKE, *Bonneville Power Administration, Portland, Oreg.*

There is a thrilling story about the way low-cost electric power is stimulating business enterprise throughout the entire Pacific Northwest—thrilling because it contains so much of the unexpected and because even the predictable future holds such great promise for still greater advances.

It is well known that throughout its entire career the Bonneville Power Administration, marketing agency for power generated on the Government's multiple-purpose projects on the Columbia River, has been opposed by certain interests whose chief argument was that additional electric power was not needed in this region—that Grand Coulee and Bonneville Dams would certainly become monuments to professional boondoggling—that they represented a sort of taxpayers' booby trap rigged up by scheming bureaucrats. Today these Federal projects can point to a brilliant war record that includes an important role in our phenomenal production of aluminum and magnesium and the planes themselves, plutonium for atomic bombs from the colossal Hanford project, ships that were spawned by the hundreds on the Columbia River, and a large array of miscellaneous products needed for prosecution of the war.

During the closing days of the war the same prophets of gloom predicted an almost complete collapse of industrial activity in the region and again urged a cessation of further construction of Federal power projects on the Columbia. But, again, their predictions have proved to be completely unrealistic, and their recommendations amount to placing this region in an economic strait-jacket—a planned economy in which the future has been overlooked. For the Pacific Northwest is in the midst of a business boom characterized by a long-overdue interest in manufacturing and processing which, believe it or not, is actually bringing the region face to face with a power shortage—the last thing that most persons would have expected.

A careful analysis of economic trends and potential load growth indicates the need for a speed-up in the construction of additional multiple-purpose projects on the Columbia River and its tributaries if we are to continue to provide adequate power facilities well in advance of actual market needs. Continuation of this policy is considered of fundamental importance by the Bonneville Power Administration in its program of making low-cost power an effective tool in developing the latent economic opportunities of the Pacific Northwest.

Ever since pre-Revolutionary days, when industry began clustering around the waterfalls of Massachusetts and other maritime colonies, manufacturers have gravitated toward a cheaper source of power, raw materials, or labor. Thus, we have the textile industry, with its high ratio of man-hours, migrating to the South to take advantage of cheap labor, while the electroprocess industries were attracted to Niagara Falls with its cheap power, and the shoe industry found itself drawn irresistibly nearer its raw material source. There is no reason to doubt the fact that the same fundamental factors are operating today—and we have only to look at what is happening in the Tennessee Valley and the Columbia Basin for an example of how low-cost power can revise the industrial directory of a region. But there are some who have refused to concede the pulling qualities of cheap power—and, strangely enough, these doubts have been expressed and advertised commercially by certain electric utility companies. Although the motive for this action is well understood, the unfortunate result is further confusion on the part of the layman as to just how low-cost power can serve to stimulate industry.

One of the most spectacular instances of industrial migration has been the way in which low-cost power has attracted electroprocess industries to the Pacific Northwest. These are the industries in which the consumption of electric energy is unusually great, running all the way from 30 to 75 kilowatt-hours per dollar value of product. In this group are aluminum, magnesium, electrolytic zinc, the ferro-alloys, calcium carbide, electrolytic caustic soda, and chlorine. These are precisely the industries which have been established in the Pacific Northwest during the last 10 years, the investment in which has already exceeded the total investment in the multiple-purpose projects that supplied the low-cost power for their operation. In describing these industries the National Resources Planning Board, in its study of "Industrial Location and Natural Resources," published in December 1942, stated in chapter 7 that: "The specifically power-oriented industries are few in number and limited in character. But where low-cost power and electroprocessing raw materials occur in conjunction, the ground work exists for industrialization on a substantial scale. This combination is the key to policy in industrial development around the public power projects of the Northwest and the Tennessee Valley."

That this ground work has been firmly established in the Pacific Northwest is amply demonstrated by the rapid growth of subsidiary industries since VJ-day. The aluminum industry provides an excellent example. Scores of small manufacturing establishments are producing a wide variety of products from the aluminum produced in Northwest plants. Although low-cost Columbia River power made it feasible to refine aluminum in the Northwest that would stand high shipping costs to eastern fabricators, the vision of a completely integrated aluminum industry within the confines of the region has always been a principal motivating factor. Recent developments have exceeded even the fondest expectations. A preliminary examination of the Portland district alone indicates between 30 and 40 manufacturers of a wide variety of aluminum products including trailer and truck bodies window frames, irrigation pipe, griddles, pots and pans, sporting equipment, furniture, and castings for a variety of industrial uses. This list can be duplicated in Spokane, Seattle, and Tacoma—not to mention a considerable number in smaller towns scattered throughout the region. The aluminum industry is sinking its roots deep, and a gradual expansion in employment opportunities directly and indirectly connected with this basic product is bound to continue.

But what about the small power user? How does low-cost power affect him? Here the story is even more fascinating than in the case of the larger, more dramatic examples, because it is becoming clear that today we are in the midst of a revolutionary change in electric power utilization—one that is strikingly analogous to a similar

change that took place 30 years ago and was brought on then largely by the demands of World War I. For it was the pressure of wartime steel scarcity that hastened the disappearance of the old inefficient factory with its multiplicity of overhead steel drive shafts, long flapping belts, and pulleys used to transfer energy from the central power plant to the machine. The system was so grossly inefficient and wasteful that a serious scarcity in steel for shafting was all that was necessary, in many cases, to tip the balance in favor of direct motor drives on individual machines. The advantages in economy, in flexibility, and over-all efficiency were so great that within a short time the old drive shaft became a museum piece.

Until recently, industrial methods of transferring heat, necessary in so many manufacturing processes, have remained in about the same relative stage of development as the drive shaft represented in transferring motive power. The central boiler, with its maze of insulated pipes transferring heat in the form of steam to various parts of the plant, is still a common sight along with a variety of other equally cumbersome devices. But in the modern factory, all this is changed—provided there is availabile low-cost power. For it is much more convenient to bring electric energy to the machine and there transform it into thermal energy by means of either electronic devices or resistance elements. These devices are proving to be much more flexible, more versatile, more easily controlled, speedier, and altogether more economical. A few examples will serve to illustrate the advantages: a nationally known company manufacturing shoe grease in McMinnville, Oreg., has replaced oil burning steam boilers with an all-electric process designed locally. Another company found that by the use of an electric steam box it was possible to form certain intricate wood and plastic shapes into an improved design for a Columbia River fishing boat. These boats are now being turned out at the rate of several a month, and fishermen claim that they are far superior to the old type. Not only are the new boats more economical than the old craft, but they are able to navigate water at a speed that could never be attained previously. The result is increased income to the operator, and a new boat manufacturing industry.

The experience of a small glove plant in Centralia, Wash., is typical of the large number of small businesses that require intermittent and usually small supplies of steam. The use of an electric steam generator has made it possible for this manufacturer to produce a high-quality glove without having to install expensive generating equipment. The experience of a cheese company in Stevenson, Wash., is typical of hundreds of food-processing plants that are switching to electric power principally for the advantages of cleanliness and sanitation, but finding that in the process they

Columbia River power puts speedy craft like this on the small business horizon.

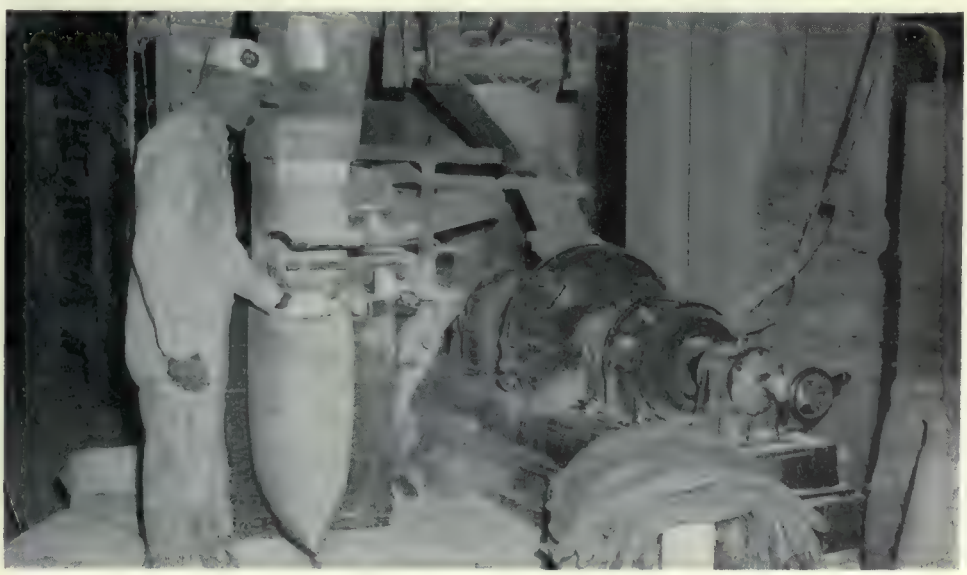
are actually saving money. The Stevenson plant is an all-electric plant where electric water heaters and steam generators have replaced a wood-burning steam boiler. Before making the change, the steam cost of this plant was about $230 per month. During 18 months of operation, the power bill for the completely electrified plant has not exceeded $80 per month. Other food processing plants that have experienced the stimulating effect of a completely electrified operation include milk-drying plants, a glucose plant which uses cull wheat and potatoes as a raw material, dehydration plants, canneries, grape-juice factories, etc.

The all-electric industrial plant is here. It has a special attraction for small industries with limited capital to invest in power equipment and a strong desire, backed by sound economic considerations, to buy all of their power, steam, and heat "over the wire." And it will certainly have just as much significance for the small industry manufacturing electroprocess equipment as the all-electric home had for the manufacture of appliances.

Without really low-cost power, most of the applications in the electrothermal field could simply not be considered. With low-cost power, however, a completely new field of activity is open to private enterprise, resulting not only in better ways of making the same product but of ways and means of making completely new products.

There are few industries in the country that are experiencing a more rapid increase in business activity than the manufacturers and distributors of farm equipment, and in the Pacific Northwest one of the "hottest" lines of farm equipment is that which is related to farm electrification. For example, at least a dozen firms, some of them completely new undertakings, are now manufacturing irrigation pipe and sprinklers to satisfy a growing demand for supplemental irrigation. Much of the irrigable land in the

This water-powered feed grinder is a far cry from the old-time hand-powered method.



No coal problem in the Northwest with this hydroelectric powered fireplace.

Pacific Northwest is of the type that can never be satisfactorily irrigated by a gravity system. Electricity is solving the problem by bringing the water to these areas via an electric power line, plus a low irrigation pumping rate. Thus, an irrigation project at The Dalles, Oreg., will use electrically driven pumps to irrigate 4,600 acres of orchard land and 1,800 acres of farm land. Pumping power rates are sufficiently low and flexible that with efficient apparatus it will be possible to use 126 kilowatt-hours per acre-inch pumping against a 700-foot head. For every difficult case such as this, there are scores of others where the problem is relatively simple. Aluminum pipe, also manufactured locally, has eliminated much of the labor cost in moving sprinklers; and when added to a low-cost power rate, the combination is unbeatable.

The electric hay drier has already proved itself in the Tennessee Valley, and is now doing the same in the Pacific Northwest. Not only is it making hay growing feasible in particularly moist areas where natural drying is difficult, but also it is producing a superior product with a much higher protein content that is claimed to more than make up for extra costs in processing.

The importance of electric power as a tool in stimulating new enterprise in the Pacific Northwest has been emphasized in recent years by significant changes that have taken place in the supply and price of competing fuels. Oil from California and sawdust waste from northwest mills have been the traditional stand-bys. Both have risen in price, while electric power rates have continued their downward trend. The result is a steady widening of the area within which electric power is an active competitor. It should be remembered that electricity becomes competitive with other energy sources before the cost relationship is in exact balance—principally because of the many advantages of versatility, cleanliness, controllability, etc.—the point at which it can be substituted depending upon the nature of the industrial process. Thus, a food industry will attach considerable value to the advantages of sanitation. Here electrification can be responsible for a superior product, and, therefore, what amounts to a new industrial opportunity with increased jobs and investment.

In a similar way electrification is extending business opportunities in the Northwest's chief activity—lumbering and wood processing. The completely electrified sawmill is rapidly becoming a common sight. It promises to be much more common as sawmills abandon the practice of generating their own steam and electric power by firing boilers with sawdust and other wood waste in favor of cheaper central station power. By doing so they eliminate their most serious fire hazard, save a high fire insurance premium, secure a dependable power source with no investment in generating facilities, in many cases pay less for the actual power itself, and also secure the use of an important raw material that used to be wasted but which has suddenly become valuable in the manufacture of pulp for paper, coating for plywood, industrial alcohol, and a growing list of other items. Here again electricity has released a raw material that can now become the basis for a large number of new and growing industries, most of which will themselves use electricity as their exclusive power source.

Low-cost electric power is responsible for another minor revolution in the Pacific Northwest, this time in the heating of homes. The idea has caught on in a big way. Power company officials agree that the only limiting factor at the moment is the capacity of distribution lines which must be almost completely rebuilt to take care of the huge potential market. This development is creating a group of new industries for the manufacture of space heating equipment. Within the last year at least five manufacturing plants have been started in the Portland area alone for the production of a central type heating unit. The same thing is happening in the other metropolitan areas of Seattle, Spokane, and Tacoma, Wash. This is in addition to the many other approaches to the problem of space heating, such as the conventional wall heater, panel heaters, floor and ceiling radiation, etc., all of which are being actively experimented on in this region. The modern home of tomorrow in the Pacific Northwest will definitely be electrically heated, and probably by a device designed and manufactured in a new industrial plant yet to be built in this region.

After watching the effects of low-cost power in the thousand and one new applications where it is being accepted, one sees that here is a new source of energy that is affecting business—large and small—in somewhat the same way as a blood transfusion can stimulate a recuperating patient. This new factory will gradually make itself felt in every part of the Columbia Basin where low-cost power is available, and small industries are bound to be the principal benefactors.

A nonbackbreaking cranberry picker in operation.

PHOTO CONTEST WINNERS

If you have been wondering what inspired many avid camera fans to devote considerable time to obtaining unusual photographs during the past summer and fall, here is what they were shooting for: the Bureau of Reclamation camera contest.

Photographs by Ray M. Reynolds, photographer of region V, Amarillo, Tex., won first and second place in the professional class. George O. Bonawit, photographer of region III, Boulder City, Nev., won third place in that class. The best picture of all classes in the amateur competition was one by Howard L. Kink, engineer at Parker Dam. The contest closed September 1, 1946.

Awards were made in 8 of the 10 subjects listed in the announcement of the contest. The winners in each subject are:

1. Irrigation farm—Taylor J. Leaming, engineer, Denver, Colo.
2. Recreational benefits—Howard L. Fink.
3. Electric power production—Mr. Leaming.
4. Flood or drought—John E. Bernhard, draftsman, Ephrata, Wash.
5. Life on an irrigated farm—Joseph W. Gorrell, electrician, Grand Coulee Dam.
6. Engineer at work on project—H. E. Winchester, geologist, Salt Lake City, Utah.
8. Workmen (action picture)—Faye E. McCumber, chief power house operator, Cody, Wyo.
10. Mechanical equipment—Bert F. Wilson, engineering draftsman, Denver, Colo.

No awards were made under subjects 7 and 9.

Honorable mention was given to LeRoy Parks, gate tender, Morton, Wyo., and to Harold R. Lee, power manager, Denver, Colo.

The first place winners in each group will receive certificates of merit. A traveling exhibit composed of the best photographs submitted will be sent to all regional headquarters, and to the larger project offices. The prize winning pictures appear in this issue of RECLAMATION ERA, and outstanding pictures will be used by other publications.

FIRST PRIZE—*Mr. Reynolds' unusual shot of hydrographer E. E. Cerny in the middle of Conchas Canal, N. Mex., measuring the water flow.*

SECOND PRIZE—*Mr. Reynolds catches the lighter side of multiple purpose development in a fishing scene on Altus Lake, near Altus Dam, Okla.*

THIRD PRIZE—*Mr. Bonawit's composite photo of the Arizona Canal, with the roadway on the side and the mountains in the background, presents a serene irrigation setting.*

FOURTH PRIZE—*Mr. Fink's study in animal life. A group of desert bighorn sheep near a summit of the Buckskin Mountains of Arizona.*

An Earthquake Is Recorded

by Dr. D. S. CARDER, *Geophysicist, Coast and Geodetic Survey, Department of Commerce,*

and THOMAS C. MEAD, *Chief, Program and Reports Unit, Region III, Boulder City, Nev.*

Do the tremendous loads imposed on the earth's crust by reservoirs behind large dams such as Boulder, Grand Coulee, and Shasta cause local earthquakes and, if so, is there a chance that these earthquakes may be of destructive nature?

Perhaps the first time that the Bureau of Reclamation had this question posed was when authorization was sought for the building of Boulder Dam. Opponents to the building of a high dam asserted that the large reservoir created would be the cause of severe earthquakes. From general engineering principles the engineers and geologists of the Bureau of Reclamation expected some measurable yielding of the earth's crust but not of hazardous proportions—otherwise the building of Boulder Dam would not have been considered. But being practical scientists, the Bureau engineers and geologists proposed to measure exactly what took place so as to have the answers in case larger dams and reservoirs should be proposed.

To carry out this program the Bureau of Reclamation first cooperated with the Coast and Geodetic Survey in the installation of strong motion accelerographs at Boulder Dam. Then the Bureau entered into a formal cooperative agreement with the Coast and Geodetic Survey to operate seismographs in the Lake Mead area to locate the origin of earthquake shocks and establish their relationship to the dam. The National Park Service cooperated in the latter work. More recently similar programs on a lesser scale have been instituted at Grand Coulee and Shasta Dams, one seismograph being installed in each locality.

It may be well to explain that a seismograph is an instrumental assembly for recording earth vibrations or waves. A complete seismograph station, such as the one at Boulder City, will have instrumental devices to pick up earth waves or vibrations in three directions at right angles. From the pick-up devices the earth vibrations are transmitted electrically to a recorder which photographs on movie film each of the vibrations as the path of a vibrating beam of light.

In every well-defined earthquake the record will show several different recognizable types of earthquake waves, each of which travels at a different speed. From the difference in time of arrival of the first two types of earthquake waves, the distance of the seismograph station from the point of origin of the earthquake shock can be determined. When the station is equipped to record motion in three directions at right angles the direction of the earthquake origin also can be determined.

To measure earthquake forces at Boulder Dam three strong-motion accelerographs were installed in and near the dam. These are special type seismographs which record vibrations during strong earthquakes only. They are especially designed to facilitate determination of acceleration, knowing which, an engineer can compute the force exerted by the earthquake on an engineering structure.

Nearly all earthquakes are vibrations caused by the rupture of the earth's crust along some line of weakness, termed as a "fault." The point of rupture may be on the surface or any distance below the surface up to several miles. It is of importance to know where active faults are. Ordinarily, important engineering structures will, if at all possible, be located so as to avoid active faults.

To locate the active faults in the Lake Mead area, three seismograph stations were constructed at Boulder City, Nev., Pierce Ferry, Ariz., and Overton, Nev. These stations form the vertices of a nearly equilateral triangle enclosing Lake Mead, which triangle serves as a convenient framework from which to locate the origin of the various earthquake shocks.

In the Boulder Dam area the first earthquakes recognized as such were felt late in 1936. The first seismograph was installed in 1938. Since 1936 about 550 shocks have been felt by local residents, and since 1938 about 4,000 have been recorded by the seismograph station in Boulder City. The heaviest shocks were barely strong enough to crack plaster or overturn unstable objects; the smallest shocks recorded were only equivalent to the explosion of about 100 pounds of dynamite at a distance of several miles. The energy of all of these shocks put together would be less than one percent of the energy expended by any one of the destructive earthquakes which have occurred in recent years elsewhere in western United States.

There is fairly definite evidence that a large number of small shocks were caused by the settlement of the floor of the reservoir under the great load which was placed fairly suddenly upon it. This load was over 40 billion tons at the time of highest water in 1941. The earthquakes were first felt after the reservoir had partially filled and, until 1942, maximum earthquake activity was definitely associated with seasonal peaks in water load. This association has not been so evident since 1942; but following 1942 the seasonal peaks have been relatively low. The points of origin of about 400 earthquakes in the Boulder Dam area have been located. These have been heavily concentrated in the general area of the lower lobe of the Lake Mead reservoir, or that part of the lake between Boulder Canyon and Boulder Dam, which part contains about 30 percent of the total weight of the water. Most of these earthquakes have their origin along the base of the granitic mountains which lie southeast and southwest of this part of the lake. Precise levels that were run when the reservoir started to fill, and again after it had filled, indicated that during the interim the lake basin had settled several inches with respect to the bordering mountains. This settlement is probably along faults which separate the mountains from the lake basin. We have then the direct cause of local earthquakes, namely, the slipping of the loaded lake basin along faults which separate the basin from the adjoining mountains. It is of

interest to note that all of the active fault zones bypass Boulder Dam by at least a mile.

At Shasta Dam the water load is not nearly as great, although several known faults are located in the vicinity. In 1944, when the reservoir started to fill, a swarm of local shocks was recorded on the nearby seismograph. Some of these were strong enough to be felt. It may be possible that the added impulse or trigger force which set off these shocks was supplied by the sudden load on the reservoir but, if so, this action soon expended itself because since 1944 few shocks which could be attributed to reservoir loading have been recorded, even though the total load has been somewhat greater.

At Grand Coulee Dam no known faults are near the dam; the dam is in a relatively unfractured formation. Hence the load of the reservoir would be expected to bend the earth's crust downward a small amount rather than rupture it along faults; there would be no sudden yielding resulting from the load, and few, if any, local earthquakes would be expected to occur. The records of the seismograph bear out this supposition. Few local earthquakes of any consequence have been recorded.

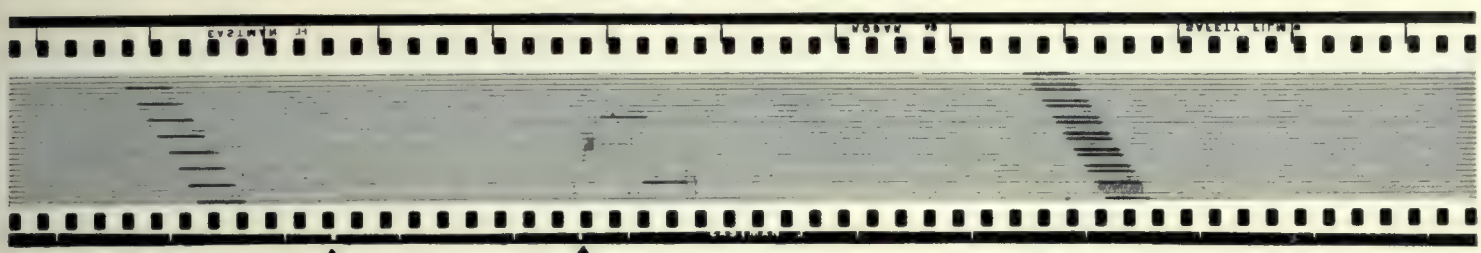
It appears that some of the answers we have been seeking are shaping up:

(*a*) In the Lake Mead area, earthquakes are associated with definite faults, none of which happen to be nearer than one mile to Boulder Dam or other important structures.

(*b*) A reservoir in the process of filling can be responsible for small earthquakes if conditions are right; namely, the load must be concentrated over a relatively small area and the underlying rock must already be fractured along definite fault lines, produced by large dynamic forces of the geologic past. Unless the rock is already faulted, loading alone will not produce earthquakes, for the extra load of the reservoir water is too small to cause new faults.

(*c*) If an area is visited by a severe earthquake, the earthquake would have occurred regardless of reservoir loading, because forces sufficient to produce a shock of this type are disproportionately greater than the inconsequential load of any reservoir which man can make.

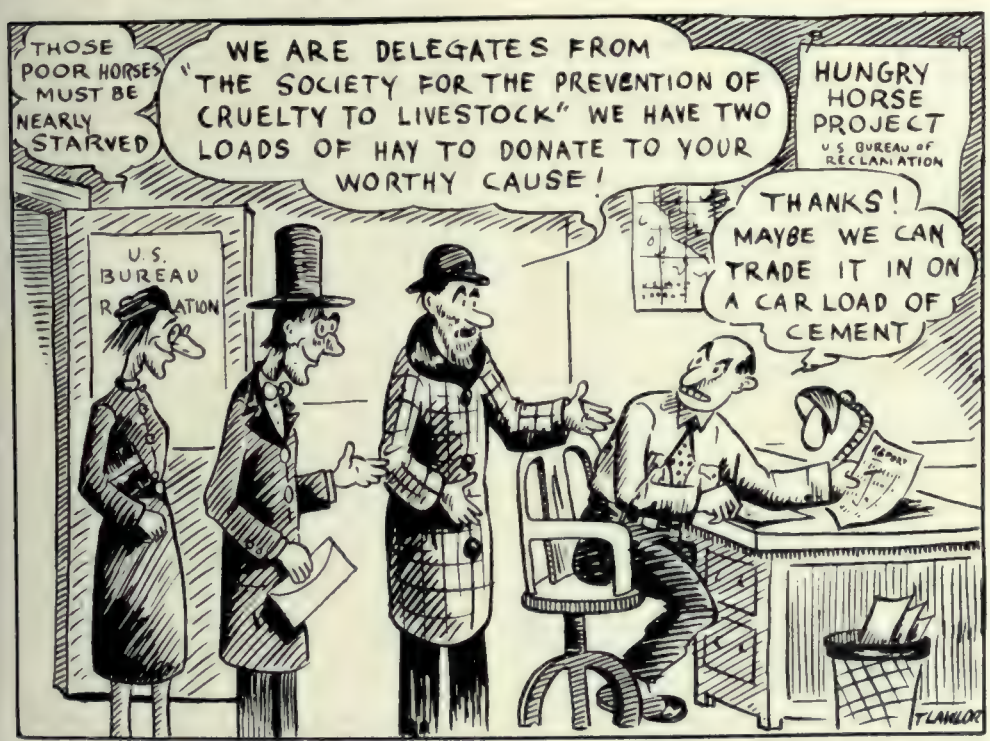
Recording of an earthquake at Boulder City, March 14–15, 1946



About mid-height of record—felt local earthquake originating approximately 5 miles from Boulder City seismograph station.

Near bottom of record—trace of strong California earthquake originating about 175 miles from the Boulder City seismograph station.

Who's Hungry Now?


THOSE POOR HORSES MUST BE NEARLY STARVED
WE ARE DELEGATES FROM "THE SOCIETY FOR THE PREVENTION OF CRUELTY TO LIVESTOCK" WE HAVE TWO LOADS OF HAY TO DONATE TO YOUR WORTHY CAUSE!
HUNGRY HORSE PROJECT
U.S. BUREAU OF RECLAMATION
THANKS! MAYBE WE CAN TRADE IT IN ON A CAR LOAD OF CEMENT
U.S. BUREAU
TLAHLOF

With massive Hungry Horse Dam about ready to become a leading figure in western Montana's economic life, an enterprising Columbia Falls newspaperman decided it was high time to make a few discreet inquiries into the giant's parentage. Specifically, he set out to learn for whom the structure, and the small creek which flows into the South Fork of the Flathead River at the dam site, were named.

It should never have been a secret. Hungry Horse Dam and the creek which bears the same title were named after two fine horses—Jerry and Tex. Years ago. in the winter of 1900–01 to be exact, David and William Prindiville were freighting oil drilling equipment from Belton, on the Great Northern main line, to a spot up the Flathead's North Fork, where there was an oil rush on at the time.

One day they had just crossed the South Fork of the river on their way to Columbia Falls when they discovered that two horses—Jerry and Tex—were missing. A month later, the horses were found belly-deep in snow and "nothing but skin and bones." A trail had to be broken and oats fed to the horses before they had strength enough to walk out.

Thus the name Hungry Horse. But the story has a happy ending and both Jerry and Tex, like their namesake to be, performed valuable services to the community. For many years Jerry pulled a Kalispell fire engine while Tex drew a delivery wagon for the Kalispell Mercantile Co.

(Editor's note: For the complete story on Hungry Horse see the February issue of the ERA.)

Contract awards soar as a result of the recent increase in the Reclamation construction limitation by the Bureau of the Budget. Contracts have been awarded for more than 22 million dollars covering construction, equipment, and supplies. Nine contracts were included in the total and five projects were affected. They are Columbia Basin, Central Valley, Colorado-Big Thompson, Deschutes, and Tucumcari. More than $16,000,000 of the total awarded will be spent on Columbia Basin, the largest job being the Potholes Dam, a key feature of the development costing more than $9,000,000. Other work includes the construction of the first section of the East Low Canal, and Long Lake Dam on the Columbia Basin project, further construction on the Delta-Mendota Canal project, the Central Valley project, the Hudson Canal and lateral system unit No. 5 on the Tucumcari project, penstocks for Mary's Lake and Estes Park power plants of the Transmountain Colorado-Big Thompson project, and additional construction work on the North Unit Main Canal of the Deschutes project. These represent the largest bulk of awards since the quarter ending with the close of the 1946 fiscal year, June 30, 1946.

Marshall Ford Dam's supervision is localized in keeping with the Bureau's decentralization program. The general supervision of Marshall Ford Dam in Texas has been transferred from the chief engineer's office in Denver to region V director, Wesley R. Nelson, at Amarillo, Tex. As a result the people affected and benefited by the Reclamation development will have a better opportunity to contact the official in charge, the primary objecive of decentralization. Detailed operations will remain under the supervision of the lower Colorado River authority of Texas.

International commission on high dams is being reorganized. The following have been nominated to serve on the Executive Committee: Michael W. Straus, Commissioner of the Bureau of Reclamation; S. B. Morris, general manager and chief engineer, department of water and power, Los Angeles, Calif.; J. L. Savage, consulting engineer, Denver, Colo.; C. P. Vetter, Chief, Office of River Control, Bureau of Reclamation, Boulder City, Nev.; and F. A. Banks, district manager, Bureau of Reclamation; Coulee Dam, Wash.

Columbia Basin lands acquired.—Purchase of almost 50,000 acres of land from the Columbia Highlands Co. under the Columbia Basin Project Act is now under consideration. If the purchase materializes, it will be the first large acquisition under the act. Almost 14,000 acres had been purchased by early fall and offers to buy had been sent out during July to landowners who will be included in the initial irrigation blocks comprising the Quincy-Winchester-Ephrata areas in the northern part of the project, and Pasco pumping locality at the southern end.

Story of the year We nominate for the "Story of the Year" the following conversation reported at last year's celebration near Coeur d'Alene, Idaho, marking official delivery of water to the 3,500-acre Post Falls unit of the Rathdrum Prairie project.

Ernie Jorgenson, farm editor of radio station KFPY, Spokane, was interviewing two young boys, ages about 5 and 7, prior to broadcasting the official ceremonies. The conversation went something like this.

JORGENSON. "And here we have two young gentlemen who are helping to celebrate the delivery of water to this fine project. Tell me, what do you think of this irrigation, Jimmie?"

JIMMIE. "Boy, it's great."

JORGENSON. "And what about you, Tommie?"

TOMMIE. "My dad says we'll all make good now and maybe I can go to college."

JORGENSON. "Tell me, Jimmie, what do you expect to grow now that you have the water?"

JIMMIE. "Oh, potatoes, alfalfa, hay, beans, and wheat."

TOMMIE. (Speaking aside to his companion) "You dope, don't you know they don't grow wheat on an irrigation project?"

Grand Coulee's left powerhouse came a step closer to completion as the Westinghouse Electric Corp. was recently awarded a contract for the last three of nine 40,000-kilovolt-ampere transformers and component parts for use in hydroelectric power development. The last three generators required to complete the powerhouse are now being built. This will only constitute half of the ultimate power output from the dam, as the left powerhouse ultimately will also have 9 generators, making a total of 18 108,000-kilowatt generators in the complete system. These machines are the largest hydroelectric generators in the world.

High price of construction calls for a thorough study of how much money water users are putting back into the coffers of the Federal Government in return for the benefits of reclamation, and on the other side of the coin how much they should have to pay in the future. This is the result of a report submitted to the Secretary stressing the need for this study before new reclamation legislation may be considered.

Bureau to operate Buffalo Rapids under a memorandum of understanding between the Departments of Interior and Agriculture. The Second Division of Buffalo Rapids project, Montana, has been designated as a WCU project under the act of October 14, 1940, as amended. Through this designation the Bureau of Reclamation is responsible for the operation and maintenance of the irrigation works and for the formulation and administration of the necessary repayment contracts relating to irrigation works constructed by the Bureau of Reclamation.

Wanted! Asce Proceedings and Transactions.—If you have any copies of the American Society of Civil Engineers Proceedings or Transactions, please send them to the Bureau of Reclamation library in Washington, D. C., to help complete our files. The Bureau's library is visited and used by engineers from all over the world. You will be contributing to engineering knowledge by helping the librarian to maintain a full record of the proceedings and transactions of this important group of scientists. The volumes desired are as follows:

TRANSACTIONS:

Vol. 89—1926
Vol. 96–100, inclusive—1932–1935
Vol. 108—1943
Vol. 109—1944
Vol. 110—1945

PROCEEDINGS:

Volumes 58–61, inclusive—1932–1935
Vol. 62, No. 1–5, inclusive—1936
Vol. 63, No. 4—1937
Vol. 64, No. 2, No. 4, Pt. 2—1938
Vol. 65, No. 10—1939
Vol. 66, No. 4, Pt. 1, No. 9—1940
Vol. 67, No. 2, No. 7—1941
Vol. 70, No. 9, No. 10—1944
Vol. 71, No. 2, No. 3, Pt. 2, No. 4, Pt. 2, No. 8, No. 9, No. 10—1945
Vol. 72, No. 1, No. 6—1946

Mail them to the United States Department of the Interior, Bureau of Reclamation Library, Washington 25, D. C.

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Approved Missouri River plan map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

2. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ended June 30, 1945).

3. *Maps of seven States showing water resources development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. (Also available from regional directors, Bureau of Reclamation, region VI, Billings, Mont., and region VII, Denver, Colo.)

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Table showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

4. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

5. *Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945*, published January 4, 1946. Fourth annual financial statement of the Commissioner of Reclamation transmitted to the Secretary of the Interior concerning operation, maintenance, and construction activities of the Boulder Canyon project during the year ended May 31, 1945. Ten cents a copy.

6. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals*, by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, seven-page mimeographed study with graphs.

7. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. (Also available from your nearest regional director.)

8. *Boulder Dam.*—Illustrated folder on the world's highest dam. (Also available from the regional director, region III, Boulder City, Nev.)

Available from the Superintendent of Documents, Washington 25, D. C.

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

Miscellaneous Publications

"500-Mile, 230-Kv. Series Compensated Transmission," by S. E. Schultz, chief engineer, Bonneville Power Administration, in *Electrical World*, August 17, 1946, page 70. Bonneville Power Administration study in the theoretical and practical aspects of series capacitance in long 230-kilovolt lines as solution to power transmission from remote hydrodevelopments.

Physical Land Conditions in the Matanuska Valley, Alaska, by W. A. Rockie, Soil Conservation Service, Department of Agriculture. Physical Land Survey No. 41, issued in 1946. 32 pages with illustrations. Bulletin contains brief descriptions of the physical features, climate, native vegetation, and existing agriculture in the Matanuska Valley, Alaska. 15 cents a copy from the Superintendent of Documents, Washington, D. C.

"Standardized Turbine Generator Units," by J. R. Carlson, Central station steam engineer, Westinghouse Electric Corp., in *Public Power*, September 1946, page 8. Illustrated. The author discusses whether "turbine standardization is just another restriction inflicted upon us, or if it is an actual benefit to users of electrical equipment."

Proceedings of California Water Conference, compiled by Irvin M. Ingerson, associate hydraulic engineer, Division of Water Resources, Department of Public Works of the State of California. A record of the California Water Conference of 1945, called by Governor Earl Warren, and held in the State Capitol, Sacramento, on December 6 and 7, 1945. 504 pages with alphabetical list of registered attendance and index of speakers. For further information write to the Division of Water Resources, Department of Public Works, State of California, Sacramento, Calif.

"An Engineering Approach to Construction Safety," by Robert L. Moore, staff representative, construction section, in *National Safety News*, August 1946, page 32. Illustrated. The importance of a sound and well-planned safety program as a means of preventing accidents on construction jobs. (*National Safety News* is a monthly publication of the National Safety Council, Inc., Chicago, Ill.)

Prewar World Production and Consumption of Plant Foods in Fertilizers, issued by the Bureau of Plant Industry, Soils, and Agricultural Engineering, Department of Agriculture. Miscellaneous Publication No. 593, April 1946. Twenty cents a copy from the Superintendent of Documents, Washington, D. C.

"Man vs. Atom—Year 1," by James H. McGraw, Jr., president, McGraw-Hill Publishing Co., Inc., in *Power*, August 1946, page 91. Illustrated.

Homesteading—Then and Now

(*Continued from page 13*)

seven towns the Government had laid out.

One clerk later reported that he registered a blind man. Dubious as to how he could make the race, he was told that the man would stand on the line, make one jump as the gun was fired, and plant his flag. He, with others, spent 2 or 3 days in the line, sleeping on the ground. Hot winds were blowing, and sand dust billowed in clouds. The heat was terrific during the day and the nights were cold. Water was scarce. Still, the registration system, though bringing hardship to many because of the conditions that arose, probably prevented many frauds. Though it was every man for himself, chivalry was not missing. At one booth several ladies asked to be allowed to register without standing in line. A redheaded Kentucky colonel spoke to the crowd and pleaded for the ladies. The men consented. In a few moments, 986 women were in line. The eyes of the men began to bulge, some groaned, but on the whole they faced the racket quite well.

When the race began, some 150,000 persons were on the line. They went helter-skelter. There were young and old of both sexes, the strong, the sick, the crippled, deaf, dumb, and blind. Some went on horseback, some in vehicles of every conceivable description, and of no description, some by train, and some on foot.

The trains were loaded. Every inch of the rooftops was covered and many hung from the sides, holding to window sills. First one man dismounted and planted his flag. In an instant, another. Then perhaps a woman and then in a moment more they were dismounting by the hundred. They came down like raindrops. They were here, there, and everywhere. Now and then a sooner (a person who went on the land too soon) would be found. Gunshots often settled the issue.

Tricks, subterfuge, and strong-arm tactics were prevalent even though the Government had set up a careful system to adjudicate conflicting claims. One man, seeing a woman behind him on the same piece of land, left it and ran for another. When he was out of sight, the woman pulled off her wrapper and there stood a man, in full and indisputed possession of a nice tract of land.

At noon when the race started, not a house or tent could be seen except the land and postoffices and a few small railroad houses. In a few hours large towns were in working order, under tents, and making preparations to annex the suburbs. One night a man slept on the ground. The next, he was in the second story of a bunkhouse. The "wild west" scenes that were enacted have been recalled to many through story and song. And by 1894, Oklahoma had a population of 212,000, and a university and other schools in full operation.

As the surveyed public lands gradually were being settled and turned over by the Government to its people, there slowly evolved a conservation and reservation theory in public land administration.

When the Reclamation Act of 1902 was enacted, much of the land and resources that the pioneer could develop without help had been settled. The Reclamation Act provided for construction of reservoirs and water-supply ditches to irrigate arid lands where the problem of water supply was too big for private interests to solve. Other expressions of this theory were the reservation of large areas for forest reserves, wildlife preserves, the withdrawals of mineral lands, and extensive classification of the soils.

An important factor was the desert land act which disposed of about 10,000,000 acres of desert and semidesert lands in Western States, useless without irrigation.

By 1940, the public domain remaining in the United States was 402,000,000 acres title to more than 1,000,000,000 acres had passed from the United States to private individuals. Of the remaining 400,000,000 acres, 203,000,000 acres were set aside for forests, national parks, Indian lands and reservations, and military, naval, and miscellaneous reservations. Grazing districts accounted for another 135,000,000 acres. About 123,000,000 acres are still unsurveyed, much of it mountain and desert land without much likelihood of becoming arable or otherwise useful to industry and agriculture.

The World War II veteran does not have the same frontier in lands that other servicemen of previous wars had. But there is a frontier, not so extensive but nevertheless one of profit to the settler, in the reclaimed lands irrigated by Reclamation Bureau projects. It is these which are giving the serviceman first, and others later, the opportunity of the past. Further, the modern settler's opportunity is richer and fuller.

The greater certainty of sufficient water for the crops is a basic element. Very few lands still unclaimed by the people can be farmed without irrigation. The sufficiently watered areas have long since been settled. Further, in certain sections to be opened, such as at the Heart Mountain division of the Shoshone project in northern Wyoming, the settler will receive the coordinated help of Federal and State agencies. The nature of help that the Bureau of Reclamation can give, beyond creating reservoirs of water by its system of dams and canals, is specifically stated by legislative and executive actions of the Government. Nor will these actions permit such help in all areas. Therefore, the Bureau may assist at times in clearing and rough leveling of land and roughing-in drainage systems. Beyond that, the Department of Agriculture and the State agricultural agencies can advise on soils, crops and general agricultural problems. The net result will be that the settler will get a quicker start in bringing the new farm unit into profitable production, and begin to repay construction charges and other expenses the Government is meeting.

No wonder then, that the rampaging homesteader of earlier years, elbowing rivals from a tract of land, might gape at the new order. The old land frontier is gone. But the frontier that now exists on irrigated farms still is one of opportunity to add to the stability and economic gain of many thousands of our people.

OUR BACK COVER

On the Way to Paradise Valley

Beautiful? Yes—but no place for a tenderfoot. The long trail from Mount Rainier to Paradise Valley in Mount Rainier National Park, Wash., looks very inviting, and is—provided you are in condition for some real outdoor exercise.

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U. S. GOVERNMENT PRINTING OFFICE: 1947

Notes to Contractors

Contracts Awarded During November 1946

Spec. No.	Project and State	Date of award	Description of work	Contractor's name and address	Contract amount
1316 [1]	Boise-Anderson Ranch, Idaho.	Nov. 29	Penstocks, penstock header, and 36 jacks.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	$683, 942. 50
1316 [2]	do	do	do	Western Pipe & Steel Co., San Francisco, Calif.	14, 319. 84
1361	Columbia Basin, Wash	Nov. 1	Aluminum doors and window frames	Seattle Bronze Co., Seattle, Wash	49, 748. 00
1404	Parker Dam, Davis Dam, Gila All-American Canal, Ariz.-Calif.	Nov. 27	4 sets carrier-current telephones	General Electric Co., Denver, Colo	22, 641. 50
1410	Missouri Basin, Nebr	Nov. 1	Construction Enders Dam, dike, and relocation Highway 61.	Wunderlich Contracting Corp., Jefferson City, Mo.	4, 109, 927. 00
1417	Columbia Basin, Wash	Nov. 6	3 overhead cranes and 1 lifting beam	Whiting Corp., Harvey, Ill	211, 000. 00
1419	do	Nov. 12	Crest railing and lighting fixtures	Columbia Electric & Manufacturing Co., Spokane, Wash.	446, 799. 65
1440	do	Nov. 13	Materials for 1 steel warehouse	American Bridge Co., Denver, Colo	130, 412. 00
1448	do	Nov. 5	1 all steel silo, 3 hoppers, 3 elevators	Noble Co., Oakland, Calif	60, 762. 00
1455 [3]	Kendrick, Wyo	Nov. 8	Electrical equipment for Medicine Bow and Hanna.	General Electric Co., Denver, Colo	32, 301. 26
1455 [4]	do	do	do	Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	11, 224. 00
1455 [5]	do	Nov. 12	do	Westinghouse Electric Corp., Denver, Colo.	18, 239. 46
1475	Columbia Basin, Wash	Nov. 1	Preparation of concrete aggregate, Adrian.	H. F. Greene & Co., Spokane, Wash	373, 612. 50
1482	Shoshone, Wyo	Nov. 27	Construction, Heart Mountain-Garland transmission line.	S. H. Reither, Aitkin, Minn	177, 586. 50
1487	Boise-Payette, Idaho, and Colorado-Big Thompson, Colo.	Nov. 12	High pressure gate assemblies	Joshua Hendy Iron Works, San Francisco, Calif.	76, 027. 00
1491	Davis Dam, Ariz	Nov. 29	Construction Davis Dam—Kingman transmission line.	Donovan, Inc., St. Paul, Minn	91, 969. 00

[1] Schedule 1. [2] Schedule 2. [3] Schedules 1, 3, 4, 5, and 11. [4] Schedule 6. [5] Schedules 2, 7, 10, and 12.

Construction And Supplies For Which Bids Will Be Requested During 1947

Estimated date bids to be invited [1]	Estimated bid opening date [1]	Project	Description of work or material
Jan. 2	Feb. 6	Boise, Idaho	100-inch butterfly valve, Anderson Ranch Dam.
2	do	Columbia Basin, Wash	18-inch hollow jet valve, Potholes Dam.
2	do	Provo River, Utah	30-inch and 18-inch hollow jet valves, Jordon Narrows pumping plant.
2	do	Rio Grande, N. Mex	8.5 by 10-foot fixed-wheel gate and frames, Elephant Butte power plant.
2	do	Missouri Basin-Hardin, Mont	Exploratory tunnels and drilling, Yellowtail damsite.
7	Feb. 11	Central Valley, Calif	Shasta Dam to Summit City highway, and left abutment parking area.
10	Feb. 14	do	Earthwork, lining and structures, Contra Costa Canal, station 1993 to 2321, and Clayton and Ygnacio Canals.
15	Feb. 19	do	Motors and condensers, Delta-Mendota pumping plant.
15	do	Colorado-Big Thompson, Colo	76-inch butterfly valve, Granby pumping plant.
15	do	do	2 turbine-governors, Estes power plant; 1 turbine-governor Marys Lake power plant.
15	do	do	Switchyard equipment, Granby pumping plant.
15	do	Columbia Basin, Wash	Bus structures, Grand Coulee power plant.
15	do	do	Unit substation for caisson power supply for spillway bucket reconditioning, Grandi Coulee.
15	do	Davis Dam, Ariz.–Nev	25-ton crane, Davis Dam and power plant.
15	do	do	Draft tube bulkhead gate, frames, and cast steel pier noses, Davis Dam and power plant.
15	do	do	Five hydraulic turbine-governors, Davis power plant.
15	do	do	Control and station service power equipment, Davis power plant and Davis switchyard equipment.
15	do	Klamath-Tule Lake, Calif	Construction of pumping plant "G."
15	do	Shoshone, Wyo	Generator protective equipment, Heart Mountain power plant.
15	do	Yakima-Roza, Wash	Earthwork and structures, lateral pump areas 1 and 9.
15	do	do	Transmission lines for pumping plants.
22	Feb. 26	Central Valley, Calif	Extension of Los Medanos wasteway, station 74+00 to 110+30.5, Contra Costa Canal.
22	do	Riverton, Wyo	Earthwork and structures, Wyoming Canal, station 883 to 1606 and laterals.
24	Feb. 28	Boulder Canyon	Pipes, fittings, valves, and strainers for Boulder City water supply system.
30	Mar. 6	Missouri Basin, Frenchmen-Cambridge	Two 60-inch hollow jet valves for Enders Dam.
30	do	Tucumcari, N. Mex	Earthwork and structures, Conchas Canal, station 3582 to 4452+46.3 and lateral unit 6.

[1] Subject to change.

n the Way to Paradise Valley

National Parks Photo

23 32 2

FEBRUARY
1947

In This Issue:

More Power to UTAH
by Governor Maw

SCIENCE Against SILT
by Koelzer and Leopold

GOLD MINE in the SKY
(Story of the Klamath Land Rush)

Public Library,
Kansas City, Mo.

THE Reclamation ERA

Reclamation ERA

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GOLD MINE IN THE SKY

High Klamath Has a "Land Rush in a Goldfish Bowl"

by Orin Cassmore, *Region II, Sacramento, Calif.*

A fanfare from the Klamath High School Band crashed up against the armory ceiling, shattered back down on a thousand eager heads crowded around the boxing ring below. Then, dead silence.

There was only the sound of the goldfish bowl, of dismal memory, creaking round and round, with the little capsules churning softly inside. It jerked to a stop. Legionnaire Olney Rudd turned his head away, grimaced as he groped inside for the first capsule. Despite his grimace, this time he drew forth not Fate, but Fortune.

Fortune indeed—for 86 fantastically lucky veterans. Eighty-six, out of a total of 1,305 whose farm experience and unencumbered assets had qualified them from an original field of 15,000, for a chance in a lottery. The prizes were 86 homesteads carved out of 7,500 acres on the Tule Lake division of the Klamath project, snuggled up against the California-Oregon border in the shadow of Mount Shasta.

Fortune, however you figure it, says things like, "I homesteaded 60 acres in 1937. Got an offer of $35,000 cash the other day," or "once they become established, settlers may expect a gross annual income of about $9,000, with a labor income in the neighborhood of $3,500." How much money would it take to bring in $3,500 at the current 2 percent? Comes to $175,000, doesn't it?

A fortune in the making, coming from a capsule, impartially bestowing its favors across the land. Eighty-six fantastically lucky veterans from the West coast, the Middle West and the East.

The Klamath project is a string of little basins and flood plains, mostly along the Lost River, which wanders through the broken hills where the Cascade Range dwindles out onto the high plains of eastern Oregon.

By and large, the project has been steadily productive, although it is nearly a mile high and can count on only 95 growing days and 9 inches of precipitation a year. The 408 entrymen of 1922, 1927–29, 1930–31, 1937, with their 26,000 acres, have done well. The other project farmers, whose 120,000 acres of private land have been taking project water for many years more, have been prosperous. The whole countryside is full of the fine homes that mean fine farms.

OUR FRONT COVER

Photo by Ben Glaha, Region I

***FORTUNE SMILED** on Fred and Velma Robison. Because we wanted our readers to see that others shared their joy, here is the full picture from which the cover was made. Although Fred had to wait until number 61 was drawn before hearing the good news, you can tell by those big grins that it was well worth it. Robison served with the 195th Field Artillery from D plus 2 until they met the Russians on the Elbe.*

Photo by Ben Glaha

Closeup of "The Pot of Gold"

Photo by Ben Glaha

Check and double check! No mistakes here.

The new entrymen will be getting some of the very best land, the vast bed of an ancient marshy lake into which Lost River finally empties after ducking in and out of the ground on a 100-mile circular course that ends up only 6 miles away from its source in Clear Lake. The land is lake-laid sedimentary stuff—sandy loam, loamy sand, peat—very deep, and rich as devil's-food cake. It has proved productive. Much of it was leased for a decade or more at from $20–$75 an acre, while the full drainage system to unwater the lake was being constructed.

Getting back to the fight arena, Klamath project superintendent E. L. Stephens cracked open the capsule with a mallet, handed the folded slip of paper with the number on it to Olney Rudd, himself an old homesteader. KFJI manager Dave Hoss shoved his mike close to Olney to make sure that the whole Mutual-Don Lee chain from Canada to Mexico and east to the Rockies heard the first number and name, which was "1—2—8, one-twenty-eight." There was a pause to get the name from Ten Broeck Williamson of the Bureau of Reclamation's Branch of Operation and Maintenance, who was checking numbers against names—"*Robert L. Smith of Banks, Oregon.*" Not among the 200 veterans and their wives, agog in the special section of seats right in front of the mike. Not there at all. Later we found that he's a veteran of the China-Burma-India theater, there for 3 years as an AAF private. Mr. Smith, at the time of the drawing, was helping his folks, the Arthur Smiths, on their 45-acre strawberry and filbert farm near Forest Grove, Oreg.

The spell of silence was broken with that first name. There was a brief silence to hear the second name—Gewin McCracken of Arlington, Va., an Easterner, who, we later learned, really comes from Alabama. But his pretty wife is a Virginian. We thought of the famous novel as the long-distance lines sped the message to the people back East. A Navy flier, a pilot who had served at Guadalcanal and Bougainville, married in April last year and in December had won a fortune for his bride. McCracken, 28, didn't really expect to get a farm—but now he is full of excitement. He will make a quick trip to Klamath very soon to look the land over. Yes, McCracken will become a homesteader.

When the first Klamath Falls name was called, fifteenth on the list, there was "stomping, whistling, shouting and near fainting as the returned warriors found the other end of the rainbow at the old Armory Building . . ." to quote the Oregon Journal, which headlined the drawing in Portland, 400 miles away. That name was Ernest M. Lindsay, the assistant county agent (of all things), a smooth-faced, thinning-haired man of 30 in a smart tweed topcoat. Ernie was evidently popular.

Here's one who didn't make it—Darrell Vernon, the missus, and little Darrelle will try again next time.

Photo by Ben Glaha, Region II

In on the ground floor. Winner No. 70, former Capt. Dale Sprout, has already worked a Klamath farm under lease.

Photo by Jon Brenneis of Cal-Pix, San Francisco

Photo by Ben Glaha, Region II

WESTERN WINNER! Philip Krizo, his wife and family, residents of Tule Lake, will feel at home on their new homestead.

Photo by Glenn Pent, Interior Department, Washington, D. C.

EASTERN WINNER! Mr. and Mrs. Gewin McCracken of Arlington, Va., talk over the future with Commissioner Straus.

Over the cheers and kidding he told us, "I was never lucky in my life before; can't even win at Old Maid."

But the people's real choice was number 254, called nineteenth, merry little Elmer Robert Metz, Jr., of Wellington, Kans. "Feeling lucky," he had just blown into Klamath for the drawings and was staying with his brothers at their Tule Lake machine shop. Elmer was honeymooning and it may have been that he was looking dreamily at Mrs. Marjorie Cook Metz, who is cute and almost 19; or he may have decided to get philosophical and resigned about his chances; but anyway he didn't recognize his number when it was called. Marjorie did, though. She punched him with her elbow. Then, she whirled in her seat and shook him: "Elmer! Wake up Elmer! It's *your number!* Wake *UP*, Elmer!" Elmer woke up. Elmer bounced to his feet with a whoop, beat himself on the chest and yelled out above the cheers; "That's ME! Elmer Metz. Folks, *Here's Elmer!*"

When we (the press, Bureau photographer Ben Glaha, Lifotographer Jon Brenneis, and Pathé News cameraman Frank Vail) got to know this couple better that afternoon, we found that this slight kid, looking all of 16 although he has just turned 21, was discharged from the Navy a year ago this Christmas as a motor machinist's mate, first class. The Navy took him just after his graduation from Wellington High (1942) and he was in on five invasions—Kiska, the Marshalls, the Marianas, Pelelieu, and the Phlippines. "In on" is right—*LSI 81* (Elmer said, "be *sure* and get that number in, so my shipmates will know it's the same Elmer Metz") was either putting troops on the beach or lying just off-shore, firing rocket salvos every time.

Even before he put his name in for a farm, Elmer had decided to come out to Tule Lake, where his father and older brothers had moved in 1936, after his father's heart went bad and he had to quit his Kansas farm.

Elmer got the necessary $2,000 to qualify for a farm by saving his money in the Navy. "The only places we got ashore, there was no place to spend it," he said.

"How do you feel?" we asked him some hours after the drawing. "Still a little numb. I've wanted a farm so hard so long, I can't believe I'm not still just wanting it." Marjorie feels fine, however, quite at ease about having everyone take her picture. She is from a farm outside Fulton, Mo. But she was working as a window decorator in town last spring and got into the background of a shot of Mr. Truman and Mr. Churchill that came out in *Life*.

Elmer's plans: To plant barley the first year to give him time to build a house from

Mac Epley and Lois Stewart of the Klamath Herald-News who put the drawing in the limelight and kept it there.

Photo by Wesley Guderian, Klamath Herald-News photographer

Pre-drawing broadcast over station KFLW. Bob McCarl, announcer, Ray Best, Bureau of Reclamation, and veteran Dean Abbott.

Photo by Wesley Guderian, Klamath Herald-News photographer

the two barracks at the old relocation center each veteran gets for building material.

Does he plan to make a lot of money? He says he isn't worried or even particularly interested about that. He is just interested in making a good home for the pretty girl he married, and the children they are going to have.

Number 25 to come up was Bert Buckingham of Fresno, Calif. We got a chance to talk to Mr. Buckingham, the only middle-aged winner in the crowd, only long enough to learn that he was in the draft for World War I, but wasn't called up—just made it this time, when over 40. He has been trying to get a good farm for some years, is presently working in the potato sheds.

Photo by Wesley Guderian, Klamath Herald-News photographer

Folks, here's Elmer!

No. 58 was Eleanor Jane Bolesta of Everett, Wash., a Wave, born and brought up on a farm, with a disabled veteran husband. We can tell you nothing more about Mrs. B., except that we are glad she won, because nobody has been able to find her yet. The Everett paper says they have moved to Stockton, and a radio search was going on as this issue went to press.

Then a middle-aged man with a heavy foreign accent, whose farm-winning boy wasn't there, was interviewed over the floor mike. He choked with tears. "Goot luck to all of dem. I wish dere was more farms. I homesteaded out here long ago. I yust hope the boys have the two 'know-hows' we had: Know how to do things; know how to do *without* dem. Den dey'll succeed."

Brett Law of Fresno was number 60 to be called. Brett sent the Bureau the Christmas telegram you see reproduced on page 29. Bob Burrows of Eugene, Bill Crawford of Corvallis, John Byron of Roseburg, Harlan Meyer of Sunnyside, and Theodore Godlewski of San Francisco, Calif., did so, too.

The Fred Robisons, who drew No. 61, just hugged each other and laughed fit to kill. Fred took time off from his glee to tell us that he was in the ETO with a howitzer company of the One-hundred-ninety-fifth Field Artillery battalion. They fought through from D plus 2 until they met the Russians at the Elbe; were out of action only 4 days in that 11 months. Quite often in that 11 months, he said drily, he didn't think his name would ever come up on anything except a grave roster. Fred was from Shedd, Oreg.; always wanted a chance at a homestead drawing.

We came at number 69, to Philip Krizo, 28, slow-talking, straight-looking, long-jawed redhead, from Tule Lake; his pretty wife, Barbara; an elf called Dorothy Marie, 2, with blond hair and brown eyes; and 8-weeks-old David, also sharing the income of a small radio shop that cannot get new sets to sell.

Philip Krizo's dad came out here from Czechoslovakia in 1912. He worked several places and finally homesteaded in the Tule Lake country when it was "just slush and thistles, with the lake water coming up to the edge of the yard." After graduating from Malin High School in 1935, Phil farmed with his father and brothers until he went off to war.

He was in the AAF 4 years, went to radar school and wound up as a radar officer navigator on P–61 night fighters in the CBI, after serving in Italy. He made some 20 intruder missions over Myitkyina and Bhamo in the late stages of the campaign in the East. He met Barbara, a Klamath Falls high-school girl, at a dance at Keno, just after Pearl Harbor. They were married more than 3 years ago, just before he went overseas. "What did you think about, overseas?" "Coming back here. I had a feeling I would make it in this Klamath country sometime."

He is going to put his land in barley or hay until he has time to build a house, then will work out a diversified farm plan, which he feels is the key to successful farming in this high country. He is sure he can make a go of it. Now he hasn't a care, except for the big thing both of them were worried about: how in the world they were going to get a baby-sitter for New Year's eve. "We haven't been out for I don't know how long," Barbara said, "and this is one celebration we sure aren't going to miss. Baby-sitters are hard to find. Seems like the girls don't want to work the way they did when I was young." She is 21 now.

Last of the local boys interviewed was Dale Sprout of Tule Lake. Dale is a tall lean youth with lank black hair, dressed in blue levis and a black-and-white-checked wool shirt hanging outside his pants. He looks just about like any other local boy should look—as if he ought to be holding up a post somewhere, shooting the breeze with friends, or playing pool, or slouching in a soda fountain, kidding with the other youngsters. He is a little older than he looks, though—23. And he spent his twentieth and twenty-first years in a P–51 with the Thirty-first Fighter Group of the Fifteenth Air Force, escorting bombers over Austria, South Germany, and Rumania. He started to work at that job just after "the bad raid" on Ploesti. He was a captain, has the D. F. C., the Air Medal with five clusters, and a Presidential Unit Citation. Went in as an enlisted man and on to cadet school after graduation from Tule Lake High School in 1941.

He married Iva LaSalle, a schoolmate, just about that time, and they have two kids—Larry, 3½, normally kept out of mischief and helped over rough territory, dangling by the middle from his father's right hand, like a B–4 bag. Lynn, a 2-year-old-girl, toddles after.

In 1946, Dale's first year out of the Army, he and a partner farmed some of this land on lease. They will make, he figures, about $10,000 between them, from beets and onions. He would like to enter the same piece of land, but figures: "My luck's just about out." The family is now living on the LaSalle place, homesteaded in 1938, which already has a nice white

house. They are going to "take it easy" for the next year by planting grain while Dale gets their own house built. Did he think about getting a farm here while he was away at war, a reporter asked? "Bud, I didn't think about anything else."

And here is one who did not make it. The wistful-looking young fellow in the flight jacket, holding the little girl, sitting near his intent, red-haired wife. His eager grin finally faded as number 86 passed. But there was nobody readier to congratulate the people who did get farms. "Man, I wanted one of those for the wife and kid. But I'm glad so many of my friends made it. We'll get one next year. Seems like a man that wants to work to build up this fine country we have out here ought to be able to get a chance to do it."

Maybe he *will* have better luck next year, when another 7,000 acres in the Copeck Bay region, former arm of Tule Lake just south of present lands, is opened up.

It's tough that luck has to play such a big part in getting these guys farms. For they are the kind of people who would make a fine addition to any community. They know their stuff. They are young and eager—that was the one thing that stood out about the veterans who got farms, or were hoping to get farms that day. As Lois Stewart, city editor of the Klamath Falls, Oreg. *Herald-News*, kept saying: "They're so young. They're so *young*. Why some of them don't look like they shave regularly yet."

It was hard to realize that they had been even younger a year and a half and 2 and 3 years ago. These very young men deserve well of their country. But they don't think much about that, a fact that was pointed out to the writer by Mac Epley, managing editor of the *Herald-News*, whose relentless publicity was largely responsible for the attention given this great show. "It isn't that we want to do something for them, or that they are looking for a handout. This isn't charity. It's giving a chance to the people who can build this country up. I saw most of the timber that was once our great wealth here, go. I saw boom and bust. I know that the real wealth of this country comes from what you can grow on this land every year, not once a century. The future of this whole Klamath region depends on setting it up with owner-operated farms, people who have a stake here—no *get-rich-quick-get-it-and-get-out* stuff. We've passed that phase, I hope." Mac should know; he has been here since 1931, has a smart newspaper, and the reams of publicity he has carried have been carried because he wants to put that message of stable, wealth-bringing development across. He tells you that part of the region's prosperity (that will be reflected in continued prosperity for his valuable paper) will come from the crops these farms grow to ship elsewhere, part from the existence of hundreds of thousands of farm families settled on land that will earn a good living for them; an income that will be spent largely in the Klamath area. He hopes some day to see a Klamath project of 400,000 or 500,000 acres.

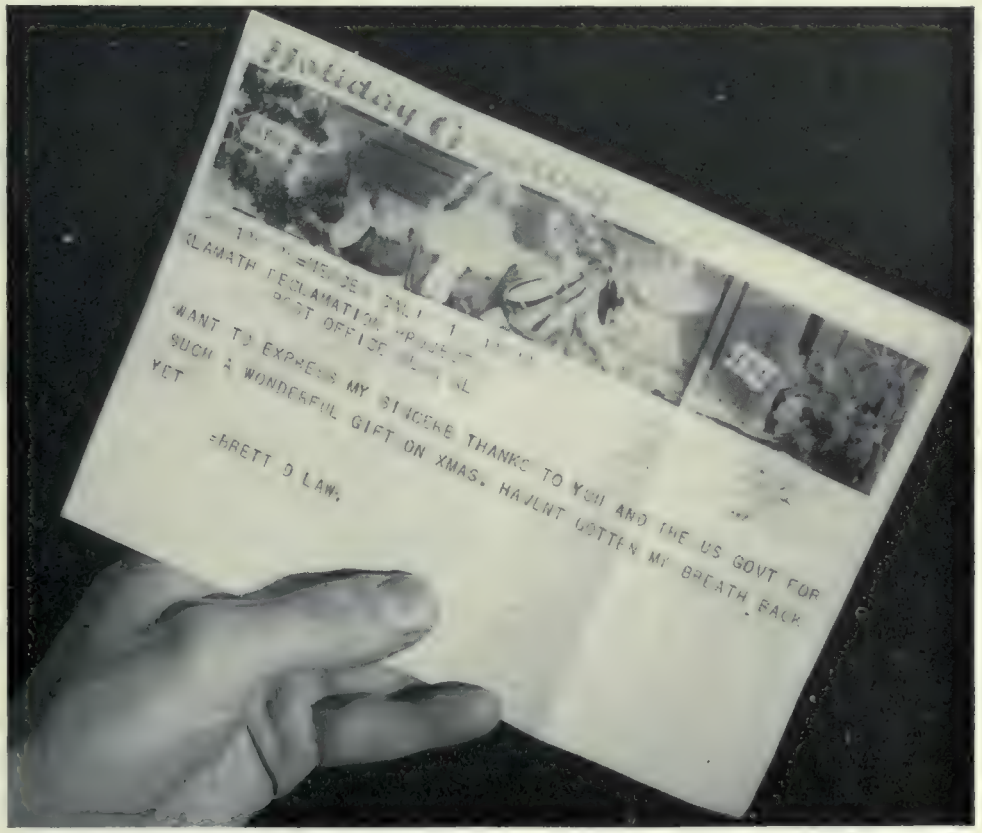

KLAMATH RECLAMATION
POST OFFICE
WANT TO EXPRESS MY SINCERE THANKS TO YOU AND THE US GOVT FOR
SUCH A WONDERFUL GIFT ON XMAS. HAVENT GOTTEN MY BREATH BACK
YET
BRETT D LAW.

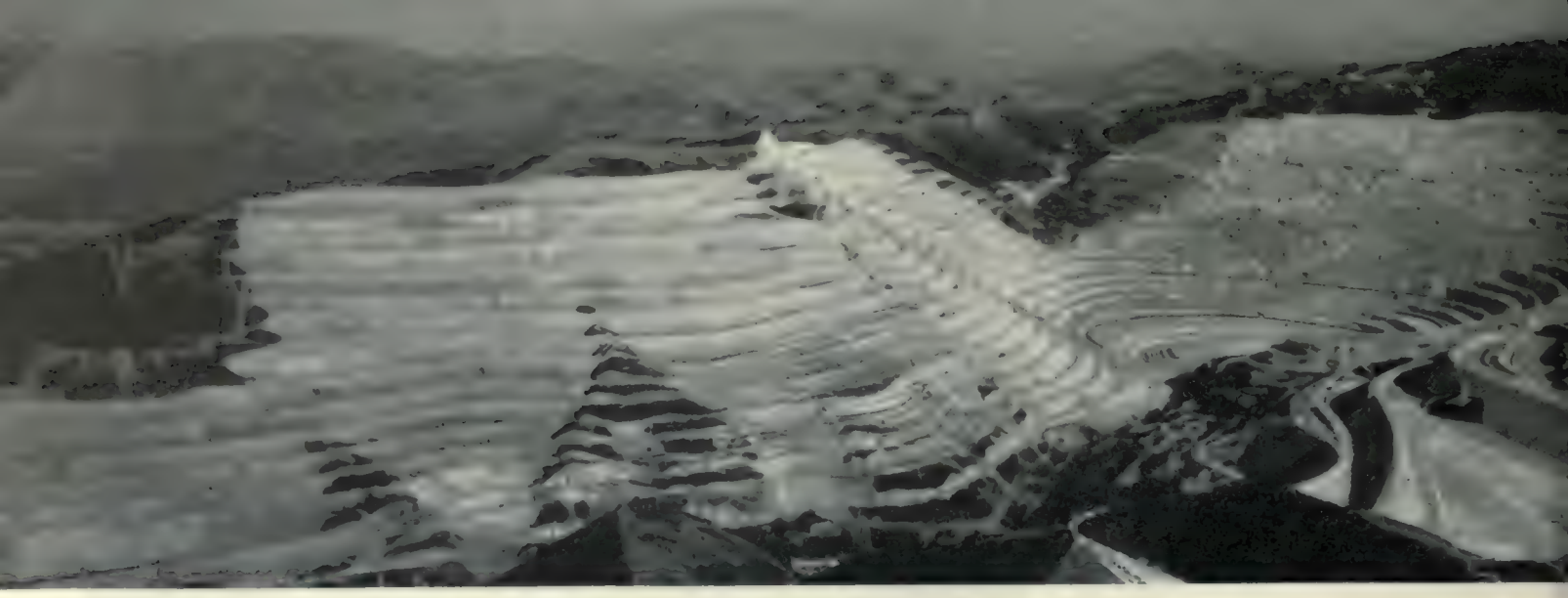
Photo by Ben Glaha

Only one of the many.

Lawrence Carr of Redding, of the California State Veterans' Affairs Council, representing thoughtful Gov. Earl Warren, spoke more formally to the same end:

> Here a grateful Nation is rewarding its men whose sacrifices so recently brought us this greatest of victories. This Nation, however, is not merely giving some veterans a chance to become owners of valuable public land. You are being given an opportunity to become self-reliant, independent, American farmers—an opportunity to join that great army of men and women who pursue a most noble and honorable profession.
>
> We observe today the American tradition of public land to the returning serviceman. But the importance of the traditional policy of public land to the veterans, which is being carried out here today, is dwarfed by the importance of another national land policy which is in evidence on this occasion. That other policy is the encouragement and establishment of family-type, resident-owned and operated farms, on newly irrigated areas through the wise application of the Federal reclamation law. This fundamental policy—a vital part of the reclamation law—was valiantly defended in its early history by an eminent Congressman who came from among you, the late Judge John E. Baker, of Modoc County.
>
> The Congress then knew, as we now know, that one of the greatest bulwarks against the destruction of democracy by false philosophies of government is the love of freedom possessed by the average American farmer living on his own family farm.

"Well said, we think," commented the *Herald-News*.



World's largest open cut copper mine. Low-cost hydroelectric energy could provide a new industry here at

MORE POWER TO UTAH . . . From the

by The Honorable
HERBERT B. MAW

Governor of the State of Utah

Utah is on the threshold of a new era . . . one that can change us from a "poor little rich State" to a "rich little rich State."

The time is coming when our sons and daughters will no longer have to leave their native State to seek opportunity elsewhere . . . there will be plenty right here at home.

I am happy to say that the promise of this new era is not so far distant that its benefits will come too late for our returned servicemen who so richly deserve the right to the prosperity which they fought to enjoy.

I sincerely believe that with firm leadership the long dreamed-of expansion of industry, mining, and agriculture—the production side of Utah's economy—is near at hand. In fact, we have already made an important beginning—the postwar operation of Geneva Steel Co., assured by its sale to United States Steel Corp.

Geneva Steel Co. is destined to attract many new industries and manufacturing firms to this State, utilizing close at hand the products turned out by the world's most modern steel plant. This is going to mean increased population with more consumer demand for everything.

Utah has plenty of room for this growth. And, with one exception, Utah has the necessary abundance of natural resources. The exception is water—the lifeblood of the soil and of daily living . . . whose energy is convertible into electricity, the "white coal" for our future industrial empire. Hydroelectric energy is a mighty force destined to play a principal role in "The New Utah."

Yes, Utah needs a "new" supply of water and needs it badly. The Beehive State in fact has only the remnants of a water supply still unused. Without new water the industrial giant in the making is going to bump his head against the inexorable ceiling of limited water supply . . . water for manufacturing . . . water for domestic use by Utah's 250,000 new inhabitants . . . water to double the amount of farm land under full irrigation . . . water to attract and hold new manufacturing firms with low-cost power!

This new water can come from only one source—the Colorado River Basin. Utah has a rightful share in the waters of the Colorado. And in my opinion, well within that share is the 600,000 acre-feet which can be brought annually into the Great Salt Lake Basin by means of the Central Utah project, being investigated by Bureau of Reclamation engineers . . . a plan for collecting the waters that flow south from the Uintah Mountains into a 110-mile conduit emptying by gravity flow into the Strawberry Reservoir . . . a plan that contemplates construction of a vast new dam on the Green River at Echo Park, 915 miles upstream from Boulder.

This could create a hold-over storage and power production reservoir from which water can be pumped to the Uintah Basin, supplying that comparatively undeveloped region with new irrigation in addition to thousands of kilowatts needed for development of the basin's mineral resources. The plan would include the possibility of constructing still another big dam farther up the Green River in Utah near Manila at the Flaming Gorge site for power purposes, and to bring water by gravity flow from the 5,980-foot elevation directly south through the Uintah Mountains to irrigate the Uintah Basin. This plan is alternative to the extent that it would obviate the necessity of pumping from Echo Park Reservoir.

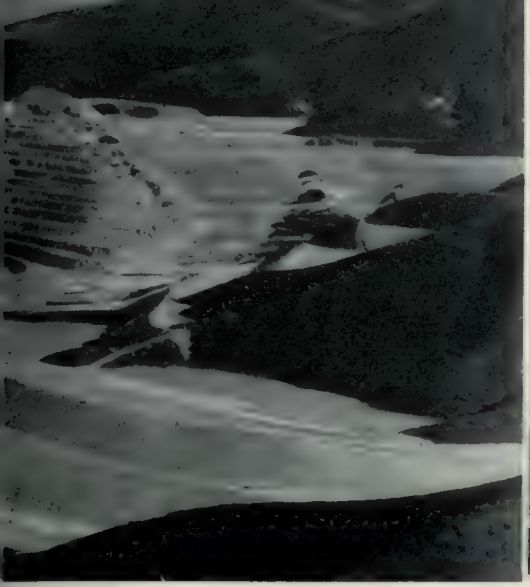
Project to Drain Mines

Yes, despite its multi-million-dollar cost, Utahans must fight for the Central Utah project. It is a solid approach to a higher standard of living for every person living in the State as well as to development of great new benefits to the Nation in the form of increased purchasing power and greater production of the commodities of farm, mine and factory needed in other sections of the country. Everything points to the economic necessity of this huge undertaking.

Mining needs power for less costly pumping of rich workings flooded by underground water. More specifically, a tunnel carrying irrigation water from the Provo River underneath the Wasatch Mountains to Salt Lake County might prove to be feasible, at the same time draining some of the richest diggings of the Alta and Park City mining districts wherein pumping costs are becoming prohibitive.

Irrigation benefits to 70,000 acres of land along the Bear River would be possible with power from the Central Utah project supplementing the output of private power plants now using water that could be utilized by farmers upstream. A similar exchange could release power water for added irrigation from the Ogden and Weber Rivers.

These are only the highlights of the Central Utah project's many ramifications. Admittedly construction costs will be high, so high that financial feasibility depends on revenue to be derived from selling the ex-



Utah Copper Company photo

Bingham, Utah.

Multi-Million-Dollar Central Utah Project

cess hydroelectric power the project will develop. Yet this crucial factor does not constitute a threat to Utah's well-established coal industry nor to our private power interests, as might be supposed, and as I shall point out later.

Two Billion Kilowatt-Hours

I am reliably informed that not more than 30 percent of the construction costs could be repaid by water users, leaving the bulk of the repayment burden to be financed by five or more potential power plants of the Central Utah project. These plants can be designed to produce more than 2 billion kilowatt-hours a year—more than one-third of the annual output of Boulder Dam.

Incidentally, we have the example of Boulder Dam to show that the lucrative returns from hydroelectric energy not only lend a big helping hand to agriculture but can pay back a rightful share of construction costs as well as put money in the bank besides.

High Reservoir Planned

You may well question that 600,000 acre-feet of water annually could produce one-third as much power as Boulder Dam which has 10,000,000 to 17,000,000 annual acre-feet of flow with which to spin its turbines. This is explained by the fact that the Central Utah project has the advantage of 3,000 feet of fall—from Strawberry Reservoir at 7,600 feet elevation to the floor of Bonneville Basin, 4,500 feet elevation—in which to make the water run a gauntlet of several hydro plants before being released for irrigation of lands extending from Salt Lake City on the north to Kanosh in Millard County on the south, the latter being more than 300 miles from the northeasternmost point where the imported water originates.

We must not forget that the primary benefit from this undertaking will be the irrigation of great stretches of land needing additional water and of many thousands of thirsty acres that could be transformed by the application of water for the first time.

Some of the most valuable new irrigation would result from bringing water to 25,000 acres of fertile land presently dry-farmed in the vicinity of Levan, Nephi, and Santaquin.

In all, approximately 450,000 acres of land will benefit from the project, thus making irrigation development the chief purpose in justifying the millions of dollars that must be spent for project construction.

Counting 40,000 acres of new land that could be irrigated in the Uintah Basin, 150,000 acres of the above total could be irrigated for the first time under the Central Utah project, 300,000 acres receiving supplementary water. Our present irrigation totals slightly more than a million acres.

Although power production is of secondary consideration, it is the work horse which must be relied upon to help pay the bill.

This brings up a question which is being voiced in some quarters, namely, "Where could we use all the power that the Central Utah project will produce?"

Surveys show that a power deficiency has been growing in Utah since 1924 and the inadequacy of Utah-produced electrical energy in 1943 necessitated the importation from Idaho and Montana of half our total power consumption.

In the Bureau of Reclamation's "Power Market Survey of Great Salt Lake Region," completed in May 1943, it is estimated that "within the next 40 years, additional requirements for electricity, together with the generation within the region of energy now imported, will create a market for 3 billion kilowatt-hours annually . . ."

And from the same source, " . . . Utah has long ranked among the leading mining States. In 1940, it stood first in the Nation in the combined value of gold, silver, copper, lead, and zinc produced. Utah copper is shipped to the Atlantic seaboard and Utah zinc to Montana for electrolytic refining. If low-cost power were available, electrolytic refineries might be established in this region. Refining of all copper mined in Utah in 1942 would have required approximately 113 million kilowatt-hours of electricity, and refining of the zinc milled in Utah in 1941 would have required 258 million kilowatt-hours of additional energy.

"A much greater potential demand lies in development of the magnesium (the Thompson, Utah, deposit of magnesium chloride is among the most promising in the Nation), phosphate, potash, and alunite resources in Utah. All require tremendous amounts of electricity for processing . . ."

A preliminary survey now being made by the Federal Power Commission and the Colorado River Committee of Utah indicates that an even larger consumption than the Bureau estimate is probable by 1980.

New Market for Coal

This talk quite naturally alarms operators of our great soft coal mines in Utah. "We are against Government subsidy of hydroelectric plants that will put coal miners out of work by competing with steam-generated power plants," they say. I say this is short-sighted. It seems to me that this viewpoint fails to take into account potential new coal markets implicit with the Central Utah project. It is my firm belief that necessary coal consumption by new industrial firms attracted by availability of ample water and power will more than offset any losses of market, not to mention the new domestic coal market represented by the

Photo by Utah Publicity and Industrial Development Comm.

Park City mines, victims of inadequate water.

Photo by Paul E. Norine, Region IV

Enjoying water benefits on the Ogden River project—Utah.

Geneva Steel Company photo

Geneva steel plant—symbol of Utah's industrial future.

anticipated 50 percent increase in population.

An example of what I mean is the phosphate fertilizer industry. What kind of a new market for coal can be visualized when it is realized that for each pound of fertilizer produced by the electric furnace reduction method, three-fourths of a pound of coal is needed? Coke is used as an agent in this process.

Investigators who have studied possible uses of fertilizer estimate that the 11 Western States could use a total of 4,400,000 tons of phosphate fertilizer annually at present. The production of that amount of fertilizer would require approximately 3 million tons of coal for use as coke in the electric furnace method of producing phosphoric acid and also for the manufacture of electrodes to be used in the furnace. In order to produce phosphate fertilizer at a sufficiently low cost to the farmer, and at a cost which would insure the optimum use of fertilizer, it is estimated that electric energy must be made available at an average rate of between 2½ to 3 mills per kilowatt-hour at the electric furnace.

I have only to mention the fact that western soils are deficient in phosphate to give an inkling of what tremendous development the commercial fertilizer industry alone can bring to the West—provided the fertilizer can be manufactured at a cost within the reach of every farmer.

And what of private power interests, of which there are several in the State of Utah?

Wholesale Power Only

I have the assurance of the Bureau of Reclamation that it is interested only as a wholesaler not as a retailer of power. It is interested in fulfilling Congress' mandate which requires the Department of Interior to convey publicly produced power to the people at the lowest possible cost. There is no intent to drive private interests out of business or to regulate the power industry. This in certainly democracy at its best and not at the expense of free enterprise. This is true, especially when the water after all belongs to the State, and people are therefore entitled to the benefits therefrom free of exploitation beyond a reasonable service charge for production and distribution.

I am open to conviction on the best way of handling the situation in Utah. It may be that a State power authority is the logical answer. The main issue, however, is cheap electricity made available to industry and to the people.

In all events the greatest needs and welfare of the people should be served. The officials of our power utilities will be, I am sure, just as interested as I in meeting the great new power markets with Utah-produced energy rather than by further importations.

Editor's Note: This is the first of several articles which will appear in the ERA dealing with hydroelectric power development and written by prominent authorities in the Colorado River Basin States.

Conference in Paris

by Leslie N. McClellan

Assistant Chief Engineer, Branch of Design and Construction, Denver, Colo.

Early last summer some 800 delegates from the four corners of the globe gathered at Paris, France, for the first International Conference on Large Electric High-Tension Systems since the outbreak of World War II in 1939. The organization, known familiarly as the C. I. G. R. E. (Conférence Internationale des Grands Réseaux Électriques á Haute Tension), was established in 1921 as a permanent international organization to promote the exchange of engineering information on technical matters related to the design, construction, and operation of large high-voltage electric power systems.

The C. I. G. R. E. meets biennially to advance the art of generation, transmission, and distribution of electricity. In addition, it serves to create and maintain friendly relations between engineers of all countries.

The air trip from New York to Paris was uneventful for Sol E. Schultz, chief engineer of the Bonneville Power Administration, and the writer, who were representatives of the Department of the Interior. Flying weather was favorable and the total elapsed time, including stop-overs, was about 18 hours.

On the return trip we were grounded 12 hours in Eire because of fog over Newfoundland. We spent the night at the little Irish town of Tipperary. On the bus ride from Tipperary to the airport we could see a little of picturesque and ancient Ireland with its feudal castles and two-wheeled farmcarts.

As we flew back over Newfoundland, the regular field at Gander was still fog-bound so we continued on to the extreme western side of Newfoundland. Just as we were over the alternate landing field at Stevenville. the cloud bank lifted and we landed without difficulty.

In Paris we were rather surprised at the relatively small amount of war damage. The old German embassy building was demolished and it was apparent that considerably heavy fighting had taken place at that point. Elsewhere in Paris pockmarks around windows and doors, caused by small arms fire, showed where sniping had occurred. Throughout the city markers indicated the spots where innumerable incendiary bombs had been dropped but either the damage had been slight or it had been repaired.

The program of the 1946 conference comprised fourteen technical sessions at which over 100 technical papers were presented for discussion. The discussions were carried on in either French or English. After each speaker concluded his talk, interpreters immediately translated his remarks into the other language. A few speakers, who were proficient in both French and English, chose to make their discussions in both languages.

Of particular interest were discussions of ultra-high voltage transmission lines of both alternating and direct current. The proponents of each of these types of transmission were about equally divided. Sweden and some other countries were primarily interested in direct current to serve the industrial load centers of Central Europe, while French engineers were primarily interested in alternating-current transmission. Because underground cables can be used in transmission of direct current, many favor this type since it is less susceptible to enemy action in time of war and does not disclose the locations of military targets as do the overhead tower lines. Another advantage of direct current transmission is the possibility of varying the speed of generating units to suit wide variations of head under which hydraulic turbines may have to operate at some generating plants, such as the one proposed at Assuan Dam on the Nile River.

However, considerable development remains to be done on high-voltage rectifiers and current interrupters before the transmisssion of large blocks of power by direct current at voltages of the order of 500,000 volts can be undertaken with assurance. The consensus seemed to be that direct-current transmission should be considered only in cases where the distance the power is to be transmitted exceeds 400 miles. For shorter distances, alternating current seems to be preferable because of lower cost, less development work required, and facility of tapping the line at intermediate points.

During the conference, inspection trips were made to the Arrighi steam generating station and the Chevilly substation, both near Paris. The Arrighi station is on the Seine River and, curiously enough, although it is one of the principal sources of power for the Paris area, it was not damaged during the war. It was forced to suspend operations just prior to the reoccupation of Paris by the Allies due to the lack of coal. After entering Paris, the American Army converted the plant to oil operation and for almost a year it was operated by fuel oil shipped from the United States. It has now been reconverted to coal burning.

The Chevilly substation is the terminus of a number of high-voltage transmission lines bringing hydroelectric power to Paris and its suburbs. It was severely damaged by bombing and fire during the war but has now been restored to service.

The conference was highly instructive and interesting to the 10 delegates from the United States because of the opportunity to exchange ideas and learn how other nations are solving their power problems. Aside from the technical value of such a conference, it contributes much to better understanding and cooperation among the nations of the world.

He went to Paris.

Unfortunately, attendance from the United States was limited because of transportation difficulties. The transportation situation should be normal by the time of the next plenary session in 1948, and everyone hopes that the Department of the Interior will be well represented and that the Bureau of Reclamation sends several of its engineers to present technical papers and participate in the discussions.

EDITOR'S NOTE:

Mr. McClellan was the first Bureau engineer to participate in an international scientific gathering following the war. Mr. Roger Rhoades, chief geologist for the Bureau of Reclamation, participated in the Second Pan-American Congress of Mining Engineering and Geology which was held in Rio de Janeiro, Brazil, on October 1–15, 1946, where he presented a paper entitled "Geology in Civil Engineering."

Scientists and engineers have always valued technical conferences, as such meetings provide an opportunity to learn the latest developments by experts working in widely separated areas. Discussions are held, scientific theories argued, and ideas exchanged. International conference activities came to a standstill during the war, but scientists who worked on a variety of wartime pursuits now have an unlimited fund of technical information and ideas waiting to be utilized in new and better ways of peacetime living.

The value of keeping abreast with scientific thought throughout the United States and the rest of the world cannot be overemphasized. The Bureau plans to have its most qualified technicians take an active part in such conferences wherever the Bureau data presented will advance scientific thinking and the Bureau can benefit through exchanges of ideas with the world's foremost scientists.

New Repayment Proposals for the Missouri River Basin

by Goodrich W. Lineweaver

Director, Branch of Operation and Maintenance

A new trail is being blazed toward modernizing the application of repayment features of the reclamation laws.

Regional directors of the Bureau of Reclamation in the Missouri Basin have opened negotiations for a proposed new type of combination water service and repayment contract with irrigation water users of Missouri Basin project units in Nebraska and North Dakota. A draft of a contract which forms the basis for those negotiations has been prepared in accordance with the Flood Control Act of 1944, under which the Missouri Basin project was authorized, and the Reclamation Project Act of 1939.

Although the contract draft applies particularly to the Frenchman-Cambridge unit in Nebraska, and to the Heart River unit in North Dakota, it points the way for others to follow as additional project units come forward in the Missouri Basin. Regional Director E. B. Debler at Denver, Colo., is in charge of the negotiations in Nebraska, and Regional Director H. D. Comstock at Billings, Mont., has responsibility for the North Dakota negotiations.

The draft was recently completed at a series of Washington conferences participated in by representatives of regions VI and VII, the Chief Counsel, the Director of the Branch of Operation and Maintenance, and the Director of Finance. The Commissioner of Reclamation, Michael W. Straus, then forwarded copies of the draft to all regional directors concerned, with instructions to use the drafts as the basis for negotiations with the water users.

Commissioner Straus, in urging full cooperation by the water users and other direct and indirect beneficiaries of the developments in expediting the contract negotiations, said that early adoption of suitable contracts by the irrigators would advance construction on many units.

"The Bureau of Reclamation is in the business of building projects to serve the people," he said. "In the Missouri Basin, we expect to transform 5,000,000 acres of dry land into irrigation oases that will combat recurring drought and enable the basin States concerned to support a larger population.

"Under the proposed contract, the water users agree to repay the distribution system construction cost as increased now by higher labor and material costs.

"The rate of repayment of those costs within the maximum period will be based on the repayment ability of the water users as determined by application of realistic analyses of agricultural and economic factors in each area. In addition, in return for the delivery of water to the irrigation districts, the water users also agree to pay a water service charge which will contain a construction component consistent with the increased costs of the water supply works.

"I have requested the regional directors concerned to press the negotiations to a conclusion with all the dispatch possible. The Congress expects the Federal Treasury to be assured of the repayment of the reimbursable costs allocated to irrigation. The Secretary of the Interior permits construction to proceed on initial features of a Missouri Basin unit such as a storage dam and reservoir on satisfactory evidence that the water users will enter into a suitable execution of the contract."

The Congress has authorized the appropriation of $350,000,000 to the Bureau of Reclamation toward the construction of the Missouri Basin project. Twenty-nine units were included in seven States in the initial list of units due for early construction.

On the basis of the original authorization of the Missouri Basin project, irrigators are to repay about 23 percent of the cost. A substantial part of project cost is to be met by nonreimbursable allocations to flood control and navigation. Power and municipal water users are to repay proportionate shares.

Part I of the contract draft as approved by the Commissioner for negotiation deals primarily with water service under section 9 (e) of the Reclamation Project Act of 1939. It provides for water service rates sufficient to cover the cost of operating and maintaining the storage and carriage systems for delivery of irrigation water to the distribution works of the unit.

In addition a construction cost element related to the cost of such storage and carriage systems is included. This phase of the contract extends for 40 years although a longer period will be necessary for the return to the United States of construction costs of such systems.

Part II is based on section 9 (d) of the Reclamation Project Act of 1939 and is

(*Continued on page 47*)

Photo by Glenn Pearl, Washington, D. C.

Left to right Floyd E. Dominy, and Eugene D. Eaton, Branch of Operation and Maintenance, Assistant Commissioner William E. Warne, Commissioner Michael W. Straus, Operation and Maintenance Director G. W. Lineweaver, Chief Counsel Clifford E. Fix, Regional Counsel W. J. Burke, Billings, Mont., Assistant Regional Counsel Don Young, Denver, Colo., John N. Spencer and Floyd M. Roush, Regional Operation and Maintenance staff, Denver, Colo.

HUNGRY HORSE

Hardy Pioneers Brave the Montana Wilderness As Work Begins on the Hungry Horse Project

by Lyle M. Nelson
Region I, Boise, Idaho

All Photos by Stanley Rasmussen, Region I

From the tree-covered slope across the river the snarls of a cougar and the barking of a dog could be heard. Just upstream two fishermen were busy hauling out hungry trout.

The low boom of a blast cut through the mountain air. Then all was silent.

Man, the giant, had invaded the wilderness of northwestern Montana. Although his coming would require a change in the habits of certain wild animals, heretofore almost sole occupants of the area, it also heralded the beginning of an new era for people of the region.

Working virtually in the shadow of towering Glacier Park peaks, Bureau of Reclamation pre-construction crews are preparing the way for multi-million-dollar Hungry Horse Dam, a structure which is scheduled to take its place alongside Grand Coulee, Boulder, Shasta, and other outstanding multiple-purpose reclamation works.

When completed the dam will be a key unit in a comprehensive, long-range program to insure full utilization of the waters of the Columbia River and its tributaries. Preliminary studies, subject to change, indicate that it will be between 340 and 500 feet high and will contain between 2 and 3 million cubic yards of concrete. It will store between 1,000,000 and 3,500,000 acre-feet of water, depending upon the height of the dam, and will support a total power installation at the site of between 142,000 and 286,000 kilowatts.

About 85,000 acres of potentially irrigable land near Kalispell may be served through the project. Besides stream regulation to increase the firm output of downstream plants (including Grand Coulee), it also will provide flood control and navigation benefits.

Project Engineer Paul A. Jones and his staff have been literally pioneering in the wilderness. Geologists are probing into the innermost secrets of the mountain fastness; diamond drillers are disturbing earth and rock formations laid down thousands of years ago; veteran-dominated crews are charting an age-old preglacial channel of the river in the proposed reservoir area. Still others are helping to build the roads, warehouses, and Government town which eventually will make possible construction of the dam itself.

Located on the South Fork of the Flathead River not far from the west entrance to Glacier National Park, the dam site is in a heavily forested mountainous area. Sites for the Government town, storehouses, and other buildings have been carved out of the forest. A road to the dam is being blasted in part out of solid rock, the nearest highway being 4 miles away.

Contracts for five big preconstruction jobs have been let. One contractor is building the road to the dam. The Government town is taking shape under two contracts, one for construction of 25 new five-room duplexes and the other for 50 prefabricated houses. Work on curbs, gutters, sewers, water-distribution system, and paved streets for the Government town also is progressing.

The Bureau is continuing with most of the preconstruction work so that plans can be drawn up and specifications written for the dam. This would make possible a call for bids on construction of the massive structure by July 1, 1947, if appropriations are made available.

Around the Government town other small towns are mushrooming. Already five have been plotted and four have occupants. One, Martin City, boasts 25 new buildings and has applied for a post office. Like Topsy, these new cities "jest grew." Despite warnings by the Kalispell Chamber of Commerce and the Bureau that construction of the dam had not yet started, new residents have flocked to the area. Old established towns such as Columbia Falls and Coram also have grown rapidly.

Most of western Montana's new citizens are World War II veterans and their families who see in construction of Hungry Horse a chance to make a dream come

On-the-spot news is their business.

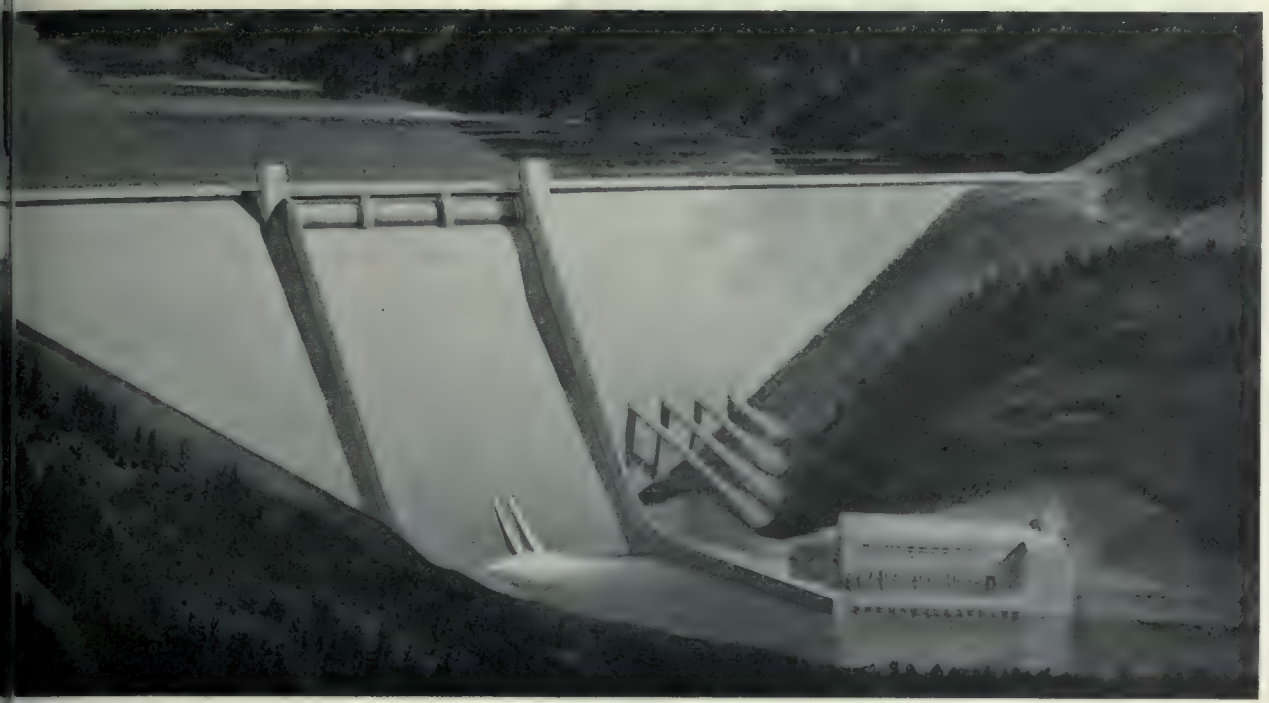
Hungry Horse—Rec

Far-sighted Engineers Richards and Hazen visualize a fuller tomorrow for Hungry Horse.

No way to beat wash day, even at the Hungry Horse project. First resident Mrs. Francis Warnock, a former easterner, displays her ability to cope with the rugged West.

Winter-resistant prefabricated homes like this one will provide a satisfactory answer to the housing situation at Hungry Horse.

ıation Newcomer to the Northwest



s conception of the latest multiple-purpose giant of the Pacific Northwest—Hungry Horse Dam.

roposed dam site—at the south fork of Flathead River in northwestern Montana.

Yes, you guessed it! Pay day always draws a crowd.

Safety first! Pre-construction crews core drilling to test foundations at proposed site.

true—a business of their own. This and the desire to get in "on the ground floor" have been motivating causes of the migration.

Life in these towns, as on the project, has taken on a near primitive aspect. Streets are of dirt (and mud this winter) and there are no sidewalks. Many of the dwellings provide not much more than shelter, ranging from small trailers to partly completed prefabricated houses.

Perhaps typical of the newcomers is Navy veteran Francis Warnock, who brought his wife and small daughter to Montana from Boston, Mass., early in April. Warnock had lost 20 pounds in a foundry where he obtained work after discharge. His failing health and the desire to go West prompted the family to head for Montana.

Warnock arrived in Kalispell nearly broke and with no immediate prospects of a job. Housing then, as now, was a serious problem. But the family found shelter in an old deserted farm house several miles from town.

Today the housing problem is pretty well licked for the Warnock family. Appointed night watchman for the Bureau, Warnock moved his family into one of the new completed houses in the Government town. Thus, he became first resident of the new city.

Even now, however, Mrs. Warnock does her cooking on a small field-type gas stove. They eat and read by a kerosene lamp, and take their baths at night in an old-fashioned tub in the backyard, often with the eyes of deer and other wild animals peering inquisitively from the darkness.

And so it has been with many of the veterans. Used to far worse during the war, they have put up with the inconveniences and hardships without complaint. Besides the new stores and shops, the area also boasts its own newspaper, a lively little weekly established in Columbia Falls by an ex-Navy man, Melvin Ruder.

Ruder edited Westinghouse publications prior to the war and dreamed of a country weekly of his own. Now that he has it, the Hungry Horse News is doing well for a fledgling.

Studies of irrigation possibilities in the Flathead Valley are under the direction of Charles S. Hazen, Bureau project planning engineer, aided by Forrest E. Richards, who also has his offices in Kalispell. Preliminary studies made by Hazen's staff indicate that increased yields of agricultural products resulting from irrigation will amount to around 2 million dollars annually.

A large part of the potentially irrigable area is now dry-farmed, and of this approximately 30 percent is devoted to the production of wheat and other small grains. The rainfall, about 7½ inches during the crop growing season, is inadequate to produce the pasture and forage that is needed for a livestock industry. Such hay crops as are produced are usually limited to one cutting per year. Some potatoes and peas are grown under dry-farming methods on these lands, but the yields are low.

Of equal importance along with the increased yields, is the stability which irrigation will bring to the valley. The present agricultural economy is to a large extent based on the price of cash grain crops such as wheat, oats, and barley. With an assured water supply, diversified farming can be practiced, giving dairying, livestock, row and specialty crops an important place in the economy.

Plenty of low-cost hydroelectric power will be the key which will unlock a treasure chest of natural resources in western Montana, according to a citizen's committee headed by Don Treloar, Al Winkler, and Leon Phillips of Kalispell. These men, "Hungry Horse" Kelly, and other long-time leaders in the community, have worked tirelessly and effectively for the project.

Low-cost power will make possible pumping of water to several hundred acres of orchard and other land impossible to reach with gravity flow. It will furnish needed energy to electrify farms, and will encourage development of mineral, timber, and other resources. A stand of pulp timber in the area is sufficient with reforestation to operate a 200-ton paper mill.

Down-stream power plants which will benefit from storage at Hungry Horse are the Polson (Kerr) plant of the Montana Power Co., the Thompson Falls plant, also of the Montana Power Co., the Grand Coulee plant of the Bureau of Reclamation, the Rock Island plant of the Puget Sound Power & Light Co., and the Bonneville plant of the Corps of Engineers.

The Bonneville Power Administration, which will market the output of Hungry Horse, is engaged in preliminary surveys of a 115,000-volt transmission line from Polson to the dam site over which energy will be brought to the project during construction and to the Kalispell area to alleviate its power shortage.

Construction of the dam and power facilities will require between 4 and 6 years, depending upon the appropriations available. Between 2,000 and 3,000 persons, most of them World War II veterans, will be employed.

SCIENCE against SILT

Engineers turn the spotlight on sedimentation to help combat this menace to the Nation's water resources.

by Victor A. Koelzer

Engineer, Branch of Project Planning

and

Luna B. Leopold

Hydrometeorologist, Former Branch of Project Planning Engineer, Now With the Pineapple Research Institute of Hawaii

Photo by William S. Russell, Region III

Sediment deposits in Lake Mead, world's largest man-made lake, just above Boulder Dam.

Engineers and scientists call it sediment. Irrigation farmers know it is simply mud and sand carried into their ditches and over their lands. Whatever its name, it is insidious, persistent, and powerful.

Silt—soil carried from land into streams—long has been recognized as a problem. And as a problem it is growing, because present-day complex developments in reclamation are vitally affected.

Sedimentation is not necessarily bad. The fertile acres in the Imperial Valley of California were created by silt boiling over from the Colorado River during its rampages. But it can wreck man's activities and works. Silt begins with erosion, which oftentimes strips farm lands of their best top-soil, or cuts ugly, damaging gullies. This soil, carried into a stream by rain run-off, can take up valuable space in reservoirs intended for storage of irrigation water. It can clog irrigation canals. It can cover good crop-producing lands with layers of useless soil.

Man cannot eliminate the forces of nature which create sedimentation. He cannot stop siltation. Even if he could, it probably would be unwise to do so. But he can learn more about it, and its effects on irrigation works and operations. And with this deeper and wider knowledge, he can devise ways and means of lessening its bad effects, and using its good points so that they are turned to man's advantage.

That, in essence, is what the Bureau of Reclamation hopes to do. Reclamation engineers, in cooperation with engineers of other agencies concerned with this problem, are pooling their resources and technical skills. Investigations are aimed at reducing the effects of sedimentation, and thus preserving and protecting the investment of the farmer and the Federal Government in the irrigation works of the West.

The problem is a long-range one. Man sees only a small part of the erosion and siltation that occurs. Usually that is during times of flood or severe storm. But there is plenty of evidence, and the effects can be measured scientifically.

However, there is an immediate purpose in sedimentation investigations. That purpose is twofold. One is to help design and construct irrigation works that will meet the sedimentation problem better in the future. The other is to help relieve the farmer and other water users of present and potential troubles. For the long-time view, the quicker we can get a sure means of controlling sedimentation, the better off we will be.

Most people, especially those living in the East, have seen the deep damage to farm lands caused by erosion. The Department of Agriculture estimates 100,000,000 acres of farms have been abandoned or impoverished to submarginal status by erosion.

When this soil is washed into the rivers, troubles start. Eastern residents can see dredging going on in all navigable streams. Constant vigil is needed to clear the channels in streams which are overloaded with sediment. Most all have seen levees, and note that they are constantly being raised. Such effort is made necessary in some of these instances because sediment is raising the river bed, and higher and higher levees are needed to hold back the water. In time, a stream bed may be as high as the surrounding farm lands, and when that happens, drainage of the farms becomes impossible, or at best, difficult and costly. Then too, ground-water levels may rise so high as to waterlog the farm land, making it unproductive.

More directly affecting irrigation are the problems of sediment in reservoirs and canals. Irrigation pumping intakes may be buried and city intakes may become useless or subject to expensive maintenance. Even if a stream is stabilized so that there is a balance between the water's scouring effect and the building up of the stream bed, construction of an irrigation dam may generate new problems by destroying that balance. Sediment will be trapped in the res-

Photo by D. D. Suggs, former Region III engineering aide

Gulleys like this one near Tucumcari, N. Mex., are typical sources of silt in the Southwest.

ervoir. The clear water below the dam then will be able to pick up materials from the stream bed and carry them on down to deposit sediment elsewhere.

Silt in reservoirs, quite obviously, can be a serious problem in the course of time. The sediment-laden water can damage moving parts in power and irrigation pumping machinery, and choke canals. The supply of irrigation water can be so reduced that the lands cannot be supplied with water. As the years go by, the reservoir's storage capacity can become so small that either new sources of water must be obtained or some of the irrigated lands must be abandoned. And the process can continue indefinitely until either of two things can happen: all the feasible dam sites in the stream will be used up and only a series of sediment-covered structures will remain; or the highly developed communities and farm areas will be abandoned.

Of course, this is a long-range view of what could happen. It need not happen, and the Bureau of Reclamation investigations are designed to help prevent such a possibility. The abandonment of a reservoir because it is filled with sediment may not seriously affect the present generation. However, unless the present trend is changed, unless we as a nation take this problem seriously, future generations may well have cause to lament our unsuccessful efforts to control sedimentation. Continued use of the best reservoir sites without adequate control of sediment will, in effect, deplete our Nation's resources just as reckless cutting of timbered lands without regard to their restoration depleted our Nation's forests. Future generations might be presented with the incongruous picture of a dam, structurally safe for many more years of use, rendered useless because its water-storage capacity is gone.

The investigations now starting are by no means the first attention by the Bureau of Reclamation to this subject. Sedimentation has long been recognized as a problem, and active steps have been taken in dam construction, for example, to mitigate the evil. But the investigations are coordinating, for the first time, all scientific and technical resources, in a concerted attack on the problem.

Bureau engineers have kept a watchful eye on the loss of water storage in various reservoirs. In some cases, they found the loss was growing at an alarming rate. Elephant Butte Reservoir, for example, in New Mexico, has lost 16 percent of its capacity in 25 years; Guernsey Reservoir on the North Platte River has lost 21 percent in 12 years; and Cucharas Reservoir in Colorado has lost 35 percent in 26 years.

One way to visualize the size of this loss is to picture the sediment deposited in Elephant Butte Reservoir each year being loaded into freight cars to be hauled away. It would take 400,000 cars, enough to make a train 4,000 miles long. Stated in another way, it means that each year enough water storage capacity is lost to irrigate between 5,000 and 7,000 acres of new land. Our job, as we can see it, must include ways of minimizing such incidents.

In the meantime, what has been done? Agencies such as the Soil Conservation Service, Forest Service, and Bureau of Land Management have worked on erosion control through maintenance of forests and other vegetal cover, by land management, the use of good farming methods, and installation of small erosion-control structures. Individual farmers, through their own initiative, have contributed much toward the prevention of erosion. Results have been good, in some cases, although the campaign is too new for results to be conclusive.

The Bureau of Reclamation, recognizing

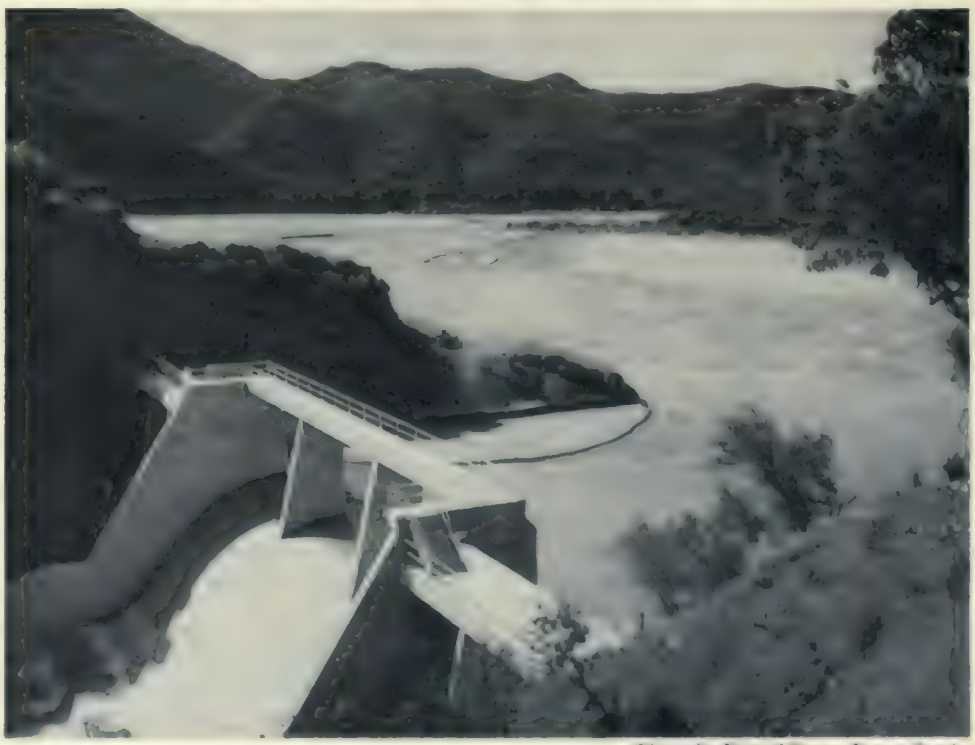


Photo by United States Forest Service

Mono Debris Dam, Calif., built for catching sediment. Note the almost-filled reservoir.

that erosion is inevitable in certain respects, has in the past planned for it with the best means available. Portions of reservoir capacity have been reserved for "dead storage" for the accumulation of sediment. Only that storage capacity in excess of dead storage has been planned for use for irrigation, power, flood control, or other active purposes. The dead storage has usually been sufficiently large to store all the incoming sediment during the time that the cost of the project was being repaid by water and power users. But as mentioned earlier, where the sediment load is large, the dead storage will eventually be used up and the benefits from irrigation will be invaded in the years to come. Dead storage, Reclamation engineers believe, is satisfactory for relatively short-term economic evaluation of a particular project, but it is unsatisfactory in long-range utilization of the Nation's resources.

In certain areas where it has been recognized that sediment carried in canals would cause undue maintenance expenditures, elaborate works have been devised to remove most of the sediment before it enters the canal. An example is the desilting works for the All-American Canal in California.

Many plans have been investigated for removal of sediment from reservoirs to recover lost water-storage capacity. Except in isolated cases with peculiar local conditions, however, the cost of removal has been found to be far in excess of the benefits derived. Therefore it will be possible in only a very few cases to remove economically the sediment from reservoirs.

Until the present, planning oftentimes has been handicapped by lack of sufficient data. For example, preliminary plans for the Middle Rio Grande area have included proposals to construct dams on tributary streams to catch and store the sediment, thereby reducing the amount carried in the main stream.

Engineers felt that sediment-free water discharged from the reservoirs would tend to pick up some of the river bed material downstream and thus tend to deepen the river channel. As a result, the river could carry larger floods within its banks. Drainage would be improved in the valley and the ground water level would be lowered to the point where danger of waterlogging farm lands would be eliminated.

But several important questions remain to be answered. Engineers are unable to predict the depth of the scour of the river bed by the clear water, or the distance downstream that it will occur, or the effect that reduction in the natural variations of stream flow may have in reducing, ultimately, the channel capacities. They also want to know if the scoured material will merely be removed from one place only to be deposited at some other point in the channel. That would merely transfer the problem from one place to another. Also to be answered are questions as to whether the scouring might not be so deep as to endanger bridge foundations or other river structures.

Photo by Emil Eger, former Region III Engineering aide

SCIENCE AT WORK. ***All-American Canal's busy silt-removing system.***

So a full solution to the Middle Rio Grande sedimentation problem must rely upon full and exhaustive investigations. And that is true of many other rivers. The Bureau of Reclamation program is designed to study fundamental problems, and conditions existing in many specific areas, such as the Middle Rio Grande, in the West.

The investigations will follow several lines. Periodic surveys will be made of all reservoirs to determine the amount of sedimentation. From these, the Reclamation engineers will learn the rate of sedimentation which can be expected in reservoirs to be built in similar areas, and will have specific data on the actual water storage space left in existing reservoirs.

A crew, equipped with a supersonic echo-depth sounder developed by the Coast and Geodetic Survey for studies of ocean floors, will make these studies. A boat will travel across the reservoirs, receiving sound waves sent from the apparatus in the boat and bounced back by the reservoir bed. The time it takes for the sound to travel from the boat and back automatically records the depth of the water. Not only will this instrument measure the depth of the water—in most cases it will also measure the thickness of the sediment deposit, recording it continuously as the boat moves on its course. The "sounder" replaces the old, tedious, and oftentimes uncertain method of measuring depth by lowering a weight to the bottom and measuring the line on which the weight was suspended.

Laboratory investigations are to be started on a large scale. These are expected to supply some of the missing links in our knowledge of the fundamental laws of sedimentation. Specific problems will be tackled. For example, models of channels will be constructed. Observations will be made on various rates of sediment load and variations in water flow, the effects of different river developments on the scour, or deposition, in the stream channel downstream. These data will serve as a check on construction plans designed to meet the sedimentation problem.

These laboratory studies may eventually involve the use of models of an entire river system, reduced in scale to the size that can be accommodated at the Denver, Colo., Federal center. Such river models may have to be built outdoors because of their space, and will cover several acres. The "model study" method has been used successfully in designing dams, locks, and channels, but so far it has been used only sparingly for solution of sedimentation problems.

Some of the most experienced sedimentation specialists have been employed to pool their technical skills. Theirs is the arduous task of obtaining basic data, of sifting, coordinating, and interpreting these data, and of deriving practical solutions to many problems. It is not expected that all solutions will be forthcoming quickly or easily. Progress necessarily will be slow at times, for it is a new and challenging need. But efforts will be concerted. Duplication will be avoided, and coordination will be promoted, through a special subcommittee of the Federal Inter-Agency River Basin Committee. On this group are engineers from all interested Government agencies. Programs and activities of all can thereby be coordinated into a well-knit plan of action.

Water users, power consumers, and all beneficiaries of water resource development in the country, and especially in the West, will profit by this work.

Juggling Water at Grand Coulee Dam

by Luther E. Cliffe

Engineer, Columbia Basin Project, Region I, Boise, Idaho

Those circus stars who juggle knives, plates, and blazing torches simultaneously are mere novices compared with the engineers who juggled the mighty Columbia River during the construction of Grand Coulee Dam in Washington State.

"Juggling" best describes the way the Nation's second largest stream was diverted from its regular channel while man's largest concrete river barrier was being built.

The problem was the familiar one that must be met early in blocking any river. Diversion techniques vary widely from one project to another, depending upon site conditions and river characteristics. Because of these differences a method that solved the problem at one site may be completely useless at another.

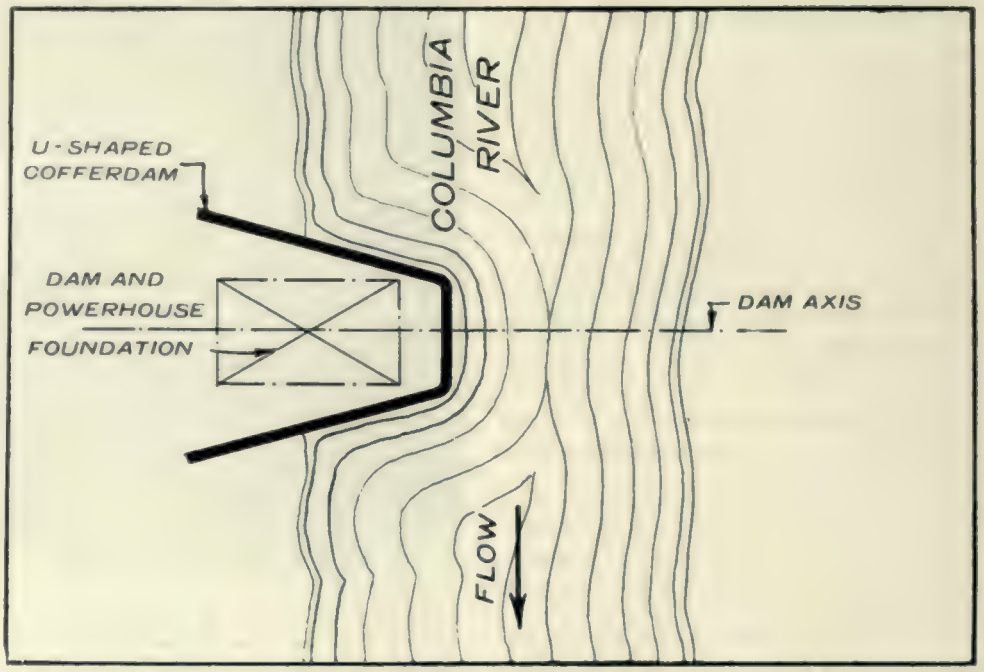
At Grand Coulee, the dam site was relatively wide (the completed dam being 4,173 feet long at its crest).

The Columbia River's dominating characteristic is its tremendous flow during flood season in early summer. The river follows a fairly predictable high-water pattern, although its peak flow varies greatly. It does not have the flash floods common to many western streams. This gentlemanly behavior is due to the fact that most of the Columbia's volume comes from melting snow and ice rather than from rapid run-off of rainfall, and the channel is so large that a small rise in water elevation accommodates a large increase in flow.

Don't think for a moment that such orderly conduct means that it was easy to control the river. The Columbia is a mighty stream, and the flow of water each season reaches a peak usually exceeding 300,000 cubic feet per second. In the 1946 season, for example, the peak exceeded 400,000 cubic feet per second. Because of the volume of water the engineers adopted an overflow-gravity-type spillway in the final design of the dam.

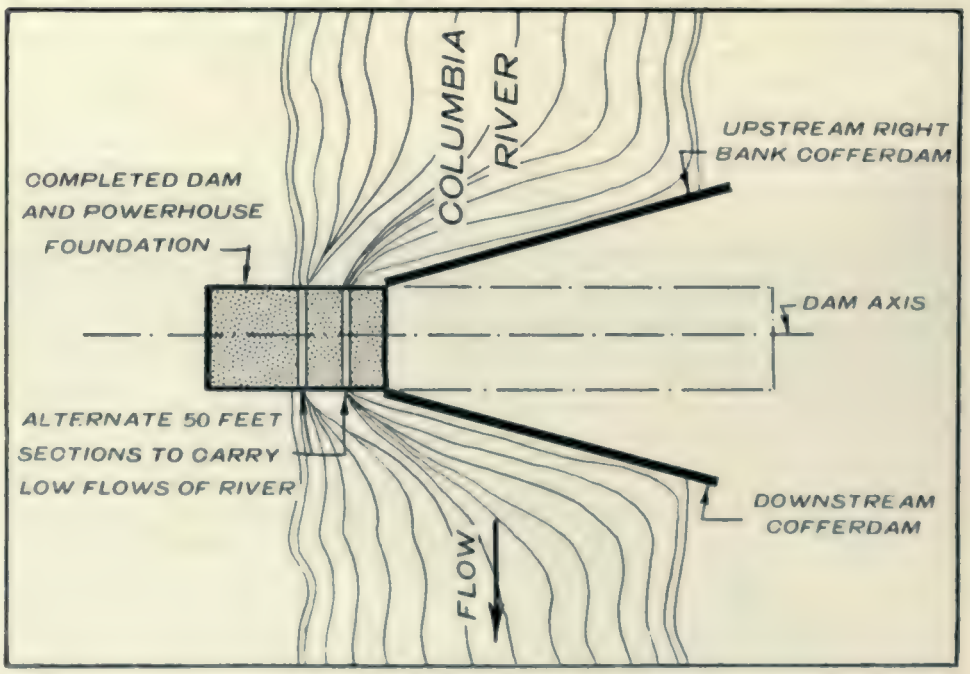
In studying the problem of diverting the river, engineers decided that there could be no adequate, permanent discharge outlets which could be utilized during construction. So they agreed that it was necessary to allow it to follow parts of its normal channel, diverting it from side to side, or allowing it to overflow the partially completed dam, always leaving enough of the structure above water to permit construction to proceed. And so we come to the "juggling" of the river.

The first phase of the diversion involved a cofferdam in the form of a large U, one leg upstream, on the left bank of the river, the other leg downstream, on the same bank of the river, with the bottom of the U extending slightly more than one-third of the way across the canyon. This U-shaped cofferdam consisted of a series of connected cells, each composed of interlocking steel sheet piling driven to bedrock, each cell filled with earth. The result was a steel-encased temporary earth dam which held the river to the center and right side of its normal channel. After pumping the water from behind the cofferdam, excavation started, the foundation rock was exposed, and workers began placing concrete for the base of the left powerhouse and the left one-third of the dam.



PHASE NO. 1

Elbowing the river aside to give the builders a chance.



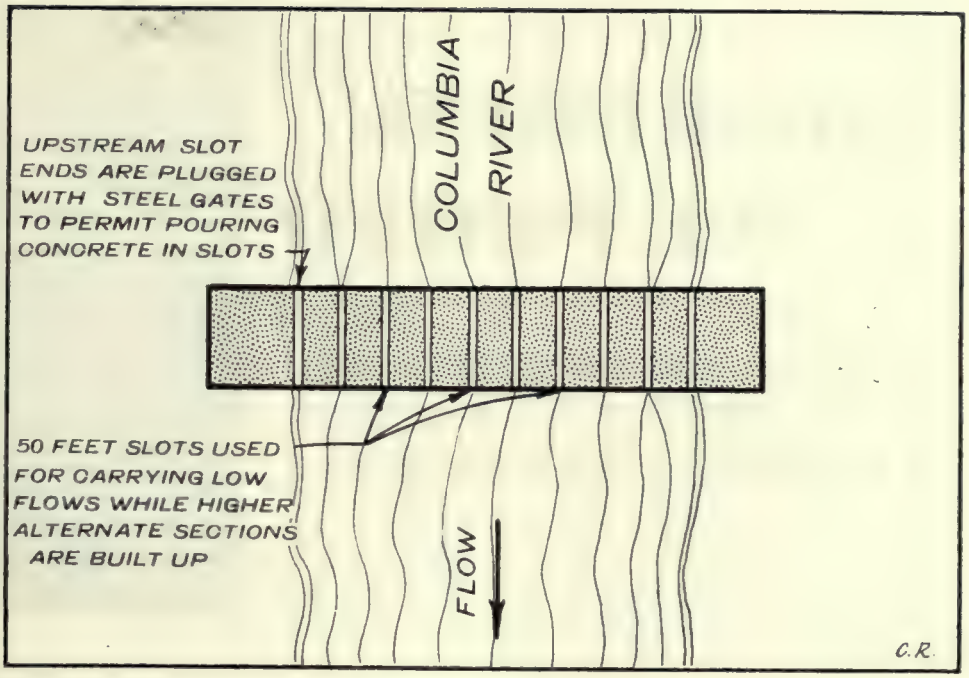
PHASE NO. 2

Pushing the river over to the other side while work goes on.

During this phase, most of the structure behind the left bank cofferdam was built to an elevation far above the usual high-water level of the river. The remainder consisted of alternate 50-foot sections, or blocks, which had an elevation of about normal low-water level. This was done with an eye to later phases of the diversion, when the river would be allowed to flow over this portion, the lower 50-foot-wide slots taking the flow during most of the year, and the flood passing over some of the higher alternate blocks as well. Also in this phase, a 100-foot section adjacent to the cofferdam was constructed to a higher elevation to form an anchor for other cofferdams to be built later.

The second phase of diversion required the removal of the first cofferdam and the construction of two more, one on the upstream side of the dam and one on the downstream side, each extending from the 100-foot anchor section across the river to the right bank. Constructing the upstream cofferdam accomplished the diversion, deflecting the river over the partially completed left end of the Grand Coulee Dam.

After the downstream cofferdam was constructed, it was possible to pump water out of the enclosed area and go ahead with excavation for and construction of the remaining two-thirds of the dam. Here again, that part nearest the abutment was constructed to an elevation well above high water, and the portion nearest the center of the old channel was built to a lower elevation, with alternate blocks carried somewhat higher than the intervening ones to give a series of 50-foot-wide slots. When this was accomplished, the cofferdams were removed.

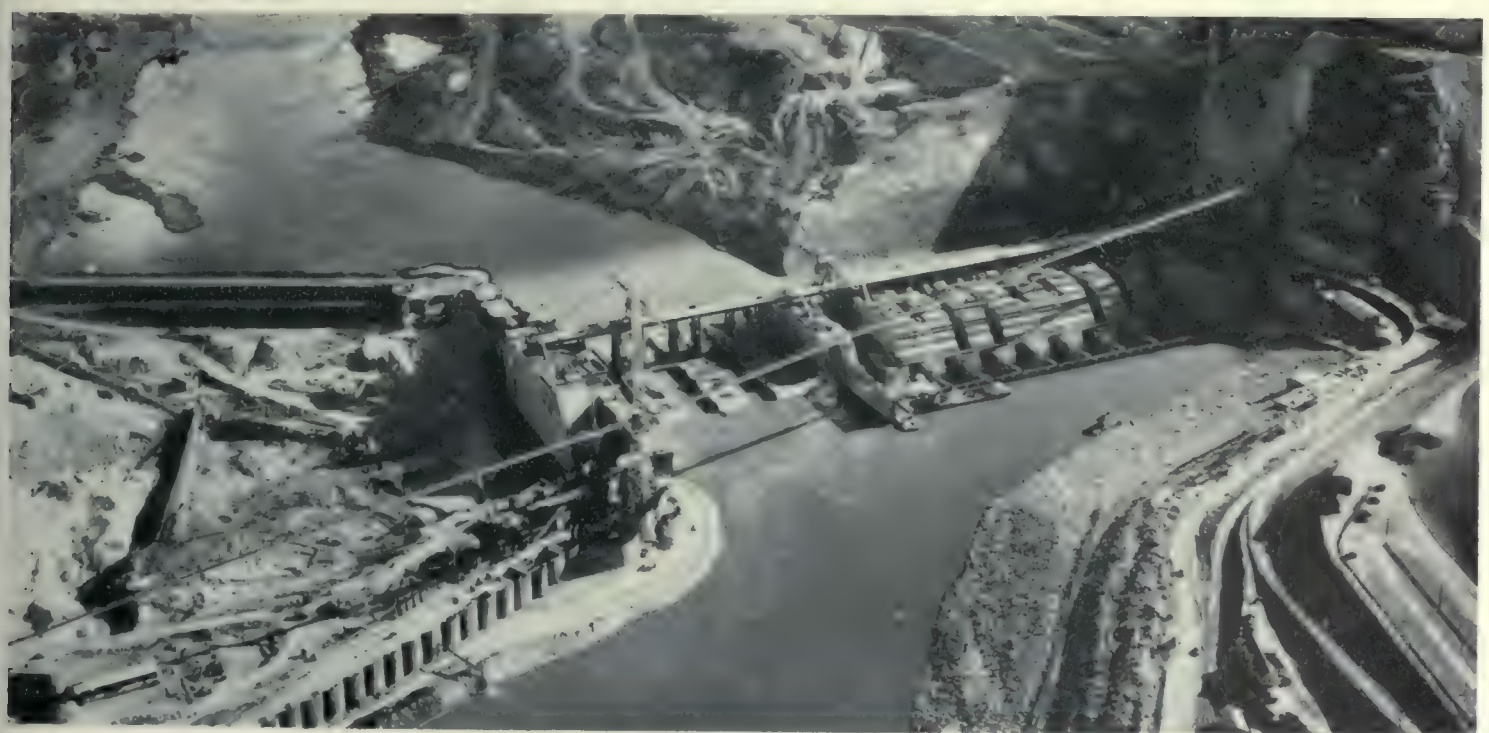

UPSTREAM SLOT ENDS ARE PLUGGED WITH STEEL GATES TO PERMIT POURING CONCRETE IN SLOTS
COLUMBIA RIVER
50 FEET SLOTS USED FOR CARRYING LOW FLOWS WHILE HIGHER ALTERNATE SECTIONS ARE BUILT UP
FLOW
C.R.

PHASE NO. 3

Juggling the river from slot to slot as the structure rises.

The third and final phase of river diversion resulted in the juggling act. No more expensive and hazardous cofferdam construction was necessary. Instead, large steel bulkheads, with rubber seals bearing on the upstream face of adjacent higher blocks, were used to plug the upstream ends of the 50-foot slots. A few lifts of concrete then could be placed. At the same time, the concrete also was being placed on the adjacent higher blocks. By shifting the bulkheads from one low block, or slot, to another, the river was juggled back and forth across the length of the spillway as the structure took shape.

There never was a period of waiting for the reservoir to fill after completing the construction of the Grand Coulee Dam. Since the river was shifted back and forth over partially completed sections of the dam, the reservoir was filling as the dam was being raised, and was nearly full when the last concrete was in place.



Photograph by K. S. Brown

HOW IT LOOKED FROM THE AIR as construction started on the east portion of Grand Coulee Dam.

PROSPERING AT PROVO

Irrigation-wise, John B. Stratton tells why he refused an offer of $150,000 for his Utah farm.

by Barrow Lyons

Chief Information Officer

Photo by Paul E. Norine, Region IV

Stratton pruning the trees of his remunerative orchard.

Few events could have affected the life of John B. Stratton and his family so profoundly as the provision of supplementary water on the Provo River project of the Bureau of Reclamation in Utah. His home is at Orem, Utah, a few miles outside of the city of Provo.

For three generations the Strattons farmed in this area of the West—always making a go of it, but not striking it rich. But the Provo project has assured a long season with ample water supply, and Mr. Stratton has been able to produce specialty crops of extremely high dollar value. At the age of 47 he has become affluent.

His story is worth starting at the beginning. James Stratton, grandfather of John B., was one of the early Mormon pioneers. He came directly from Liverpool, England, in 1850, a sailor by trade, and settled in Salt Lake City.

When the Mormons began to colonize the intermountain area, James Stratton took up a farm at Cedar Fort, Utah. Then Brigham Young sent him to the Moapa Valley, where he irrigated out of Muddy Creek and the Virgin River in what is now the State of Nevada. He went to Provo in 1867 and helped to build the first irrigation canal in the Orem area. Water was diverted by irrigation ditch from the mouth of Provo Canyon, named after a French beaver trapper by the name of Provost.

James Stratton's son, John H. Stratton, who was the father of John B., was born in Cedar Fort, Utah, in 1860. When he was 20 years old, he left Provo and homesteaded in what is now Orem.

John B. Stratton was born in 1899. When he was 17 years old, he rented a ranch from his father and purchased it 2 years later.

When John B. was only 11 years old, his father purchased 160 acres of irrigated land in Benjamin, Utah, for $1,000, which land is now under the Bureau's Strawberry Valley project not far from Provo. Shortly after the Bureau of Reclamation delivered water to the Strawberry Valley project, the father sold this land for $8,500.

John B. was able to combine starting a farm of his own with going to college. He entered Brigham Young University in 1918, the year in which he purchased 30 acres of land on time from his father. His father gave him 13 acres when he married in 1920, and shortly after he was graduated from college in 1922, he purchased from a local bank an additional 63 acres under the upper (Provo Reservoir) canal. It is this canal which the Bureau of Reclamation is enlarging and improving and which had enabled this Mormon community to change from grain and alfalfa to the much more highly profitable fruit specialties.

On the matter of farming, Mr. Stratton speaks for himself:

"I have raised every kind of crop that grows in this valley except celery. These crops include sugar beets, grain, hay, and all kinds of fruit: apples, apricots, prunes, plums, pears, tomatoes, dewberries, raspberries, strawberries, and cherries. In the operation over the years, we have found fruit much more profitable than field crops, so we have eliminated those. Field crops would grow just as well up here on the high bench, but the others are much more profitable. We are specializing in Bartlett pears, Bing and Lambert cherries, Chinese apricots, and Moor Park apricots.

"Several years ago we imported buds of an improved Hale peach from California. We grew them on our nursery stock which produced very sturdy trees. The production was twice as great as with the ordinary Hale peach."

Nineteen forty was the first year in which the Bureau of Reclamation delivered some water to the Provo River project. The following season its large canal was full throughout the year. Nineteen forty-two was an exceptionally good crop year for the project.

"Our best year was 1 year ago in 1945," continued Mr. Stratton. "We sold $55,483.74 worth of fruit. In 1943, we had a total freeze-out, the only one I have ever experienced. That, of course, was the worst year we ever had. During the years preceding the war, we made from $3,000 to $5,000 a year above all of our expenses. However, during those years, I put most of all we made back into the farm because costs were low.

"Let me explain why the Bureau of Reclamation has meant so much to us. Before the Provo River project came, we had virtually no storage capacity for late season water. We ran the water onto the land from the ditches which our fathers had built. Ordinarily, during the spring, there is a high run-off period that comes toward the end of May or the early part of June. Then the streams gradually diminish and by summer they are generally very low. During the low year of 1934, the entire amount of water available was barely enough for two good irrigation applications.

"One summer, I had 10 acres in Italian prunes. We had a drought and 2,000 bushels of prunes dropped on the ground because we could not give the orchard one more irrigation. Assurance of a continuous water supply throughout the summer whenever we needed it encouraged us to go into the more profitable fruit crops, and I think this Orem area eventually will give up field crop farming."

"Of course, we had unusually high prices during the war period, but in the few years during which the Bureau has been delivering water on this project, I believe I have made enough additional money from my crops to pay off all of my portion of the construction charges."

The Bureau has a contract with the Provo River Water Users' Association, under which the association pays for water delivered. This money will be applied to the construction charges.

A similar project, which already has experienced economic change because of storage water is the Bureau's Weber River (Echo) project, 75 miles north of Provo. Before this project was built, the annual gross crop returns on the area served had never amounted to more than $2,000,000. During the 1945 season, the gross crop returns were $13,700,000. Before the project was built, only 5 percent of the area was in diversified farming, most of it being in hay and grain. Now, only a small percentage is in hay and grain, the balance in more highly remunerative crops.

Mr. Stratton now owns 60 acres of fruit land. On this he has a two-story packing house with washing machines and all types of fruit graders. He has a cold-storage plant equipped with the new type of Freon automatically controlled refrigeration. There is another packing shed and there are tent cabins with a bathhouse for seasonal help. There is a 30- by 60-foot storage shed for box materials, a small tool house, and a barn with cement corral to conserve manure for use in fertilizing the land.

"I feed about 40 head of cattle in the winter," continued Mr. Stratton. "The profits from the cattle come from the fertilizer that is used on the orchards in spite of the fact that I buy all of my hay. We haul out and spread the manure just as soon as it is made and disk it in if possible, otherwise in the winter we spread it on the snow. It leeches out where you want it. You can increase yields just about double by using fertilizer.

"Out of one block of 6 acres of cherries this year, we produced 7,000 crates which brought a gross return of more than $17,000. Last year, on 5 acres of apricots, we packed 8,500 half-bushel baskets. That is about 825 bushels to the acre. Last year, they brought $3.76 a bushel, but this year they brought $3.30 a bushel. Figure it out for yourself. Last year, the apricots grossed almost $3,000 an acre."

The Strattons live in a nine-room house with an additional room in the basement. They heat the house with an air-conditioning coal furnace, have hot and cold water, showers, and electricity with which they cook. Equipment on the farm includes two spray pumps which cost $5,000, two caterpillar tractors, orchard disk and markers, three trucks and a touring car.

"A man who wanted to buy my farm, home, and all equipment, including the storage plant, offered me $150,000 this year," said Mr. Stratton. "Why should I sell it? I have had only one total crop failure in 25 years, and 2 years' partial failure due to frost. This farm enables me to enjoy life to the very fullest. I no longer have to do all the heavy work myself. I find time to fish and hunt, to go to shows and dances.

"Mrs. Stratton and I take two vacations every year. This summer we spent 2 weeks in Yellowstone, and last December we spent 8 or 10 days in California—long enough to appreciate home when we got back.

"We hunt deer, elk, pheasants, and ducks. Sometimes we go hunting for deer as far as 200 miles away, but most of our deer hunting is within a radius of 50 miles. We have killed elk near the ranch, but the State Game Commission moved that herd out of this area. The elk came down from the hills and ate the fruit buds off the trees. Pretty aggressive critters!"

The Strattons have five children living. The oldest is John D. Stratton, 25 years old, who has a 35-acre orchard across the highway from the paternal ranch. He is married, has purchased his ranch from his father and is doing well. Mar Jean, 12 years old, and Richard, 8 years old, are still going to school.

"We have always kept our children in school as long as they'd stay there," explained Mr. Stratton. "But the two girls, Ruby and Helen, decided to get married after 2 years of college. Their husbands were called to the service. They are now doing well with their husbands on fruit ranches which they are purchasing from me on a time basis."

Mr. Stratton has had an architect draft plans for a beautiful modern house which will be built as soon as materials become available. It will be on the high bench of Orem, looking up toward the mountains and far out over the fertile area upon which the Mormon pioneers established their home in the desert, almost 100 years ago, based entirely upon irrigation.

Another example of what can be done upon this land when sufficient water is applied was discovered in the case of E. W. Hoopes, who works in the plant of the Columbia Steel Co. near Provo. In 1945, from one-half an acre of raspberries, he received $1,700. He has a small place—three and a half acres—in raspberries, cherries, apricots, and peaches, and expects this plot to pay for his small home in 3 years.

The bench landowners above the project canal will also profit from the project. At present, the water supply from mountain streams is only partially available to them during the flood season, as the farms below have the water rights. The bench owners have purchased water in the project which is released to the lowland areas in exchange for the higher water being retained on the highlands.

Photo by Paul E. Norine, Region IV

Regular use of fertilizer is an important part of his horticultural plan.

Correction

Instead of the last two sentences in the fourth paragraph of the story India's Unfinished Business (p. 275, December issue) the following should have appeared "This province has 16,000,000 acres under irrigation."

RUTH F. SADLER, *Editor.*

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Approved Missouri River plan map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

2. *Maps of seven States showing water resources development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. (Also available from regional directors, Bureau of Reclamation, region VI, Billings, Mont., and region VII, Denver, Colo.)

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Table showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

4. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

5. *Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945*, published January 4, 1946. Fourth annual financial statement of the Commissioner of Reclamation transmitted to the Secretary of the Interior concerning operation, maintenance, and construction activities of the Boulder Canyon project during the year ended May 31, 1945. Ten cents a copy.

6. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals*, by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, seven-page mimeographed study with graphs.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

Miscellaneous Publications

"Davis Dam Scheduled for 1949 Completion," in *Engineering News-Record*, August 22, 1946, page 84, illustrated. Major features of Davis Dam on the Colorado River—a $7,000,000 project whose construction was halted by the war, but now resumed—are a 3,900,000-cubic yard earth- and rock-fill dam, a by-pass channel to handle a maximum flow of 60,000 cubic feet per second during construction, and a power plant with an ultimate capacity of 225,000 kilovolt-amperes.

DDT and Other Insecticides and Repellents Developed for the Armed Forces, prepared by the Orlando, Fla., laboratory of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture. Miscellaneous Publication No. 606, 71 pages with illustrations, issued August 1946. Originally written and issued specifically for members of our armed forces and others concerned with the problems of controlling insects and insect-borne diseases affecting military personnel and civilians in occupied territory, this publication presents materials and methods of value for both military and civilian use under peacetime conditions.

Irrigation Requirements of California Crops, a cooperative report prepared by Arthur A. Young, irrigation engineer, Soil Conservation Service, United States Department of Agriculture, for the Division of Water Resources, Department of Public Works, State of California. Bulletin No. 51, 132 pages with bibliography, issued November 8, 1945. Comprehensive compilation of data that have been published or made available from public and private files, as well as unpublished findings resulting from cooperative research studies, pertaining to agricultural crops common to California.

"Mexico's New Soil and Water Conservation Program," by Phoebe O'N. Faris, in *Agriculture in the Americas*, November 1946, page 175, illustrated. Mexico, faced with serious diet deficiencies in many areas, is taking an important step toward returning badly eroded farms and grazing lands to productivity. (Agriculture in the Americas is issued monthly by the Office of Foreign Agricultural Relations, United States Department of Agriculture.)

Construction, issued by the Bureau of Labor Statistics, United States Department of Labor, September 1946, 73 pages (mimeographed). Statistical study of employment, volume, earnings and hours of work; prices of construction materials and machinery; rents and characteristics of rental housing and vacancy rates, and wage rates in the construction industry.

"Construction Legislation in Seventy-ninth Congress (second session)," in *The Constructor*, September 1946, page 45. Brief summaries of bills enacted and bills which failed to pass prepared for the layman.

"Colorado River Basin Development," in *The Constructor*, August 1946, page 41. The Bureau of Reclamation has submitted a preliminary report on development of the Colorado River Basin under existing government agencies to the Department of Agriculture, the Corp of Engineers, and the Federal Power Commission—members of the Federal Inter-Agency River Basin Committee—for their review.

The Magic Valley

By James A. Robertson, *chief clerk, Valley Gravity project Region V*

EDITOR'S NOTE: The Magic Valley referred to in this article is not to be confused with the Magic Valley of South Central Idaho

The natives, and those who remain long enough to eat a pink grapefruit or peel a giant orange, call it "The Magic Valley." That the appellation has any connection with legerdemain would be denied by any of the chambers of commerce.

Geographers—those unromantic fellows so keenly versed in the science of the earth in its relation to human life—insist upon referring to this tropical tip of Texas, which points directly toward Latin America, as the Lower Rio Grande Valley. But to the fortunate souls who bask in its sun or spark in its moonbeams, filtered through sky-brushing palms, it is "Magic Valley."

Following my release from the Army in New Jersey, I reported for duty at McAllen, self-proclaimed capital of "Magic Valley," to assist in the administrative planning by the Bureau of Reclamation for construction of a gravity canal and a drainage system to serve 700,000 acres of fertile soil.

I arrived in "Magic Valley" last January by the way of Amarillo. From the subzero weather of Jersey to the subzero weather in Amarillo was merely one step to another. But from Amarillo to "Magic Valley"—a mammoth stride.

Approaching San Antonio, I lowered my car windows several inches. Down by the Alamo, in old San Antonio, I lowered the car windows as far as possible, and removed my topcoat. I haven't seen it since.

It is a long drive of more than 700 miles from Amarillo to "Magic Valley." A dull dreariness had crept over me between San Antonio and my destination. Suddenly, however, I got a whiff of orange blossoms and my eyes focused on dreamland.

To be in civilian clothes after 4 years in the service and without a War Department special travel order telling me where to go, how to go, and exactly what time to get there, was in itself inconceivable. But to jump from the icy fog and congested streets of the East to the clear, warm skies and scented air of one of the most beautiful valleys in the world was almost beyond human comprehension.

This was magic, yet I soon learned that "Magic Valley" had more tricks up its sleeve. Magicians produce birds and animals from a hat—"Magic Valley" produces cabbages and fruits of the earth in stupendous quantities at unbelievable seasons.

A local citizen—one of those conservative Texans noted for their understatements—warned me to be careful when I dug in the ground with my bare hands. He said the soil was so rich that my fingers were likely to sprout.

There is no denying that some of the land bears four complete crops and each crop represents a full year's production for farm land in northern climates. Here, in the dead of winter, the farmers and town gardeners gather lettuce, squash, tomatoes, oranges, grapefruit and lemons. Coats or other wraps are unnecessary, uncomfortable. There is no winter in "Magic Valley."

This is my first experience with citrus groves. Previously, I envisioned them to consist of trees with fruit hanging like apples or pears. That is not the way of it. Healthy trees resemble giant bushes, with clusters of grapefruit and others almost solid with oranges or lemons. Some of the better groves produce fruit that sells for as much as $1,700 an acre. This year the mature groves provided crops valued at as much as $4,000 an acre.

The production of winter vegetables, citrus crops, Brahma cattle and local farm industries in the four "Magic Valley" counties will amount to more than $125,000,000 this year. If that amount were distributed equally among the 75,000 agricultural population of "Magic Valley," there would be more than $1,600 for each man, woman and child.

Repayment Proposals

(Continued from page 34)

concerned principally with provision for the repayment in 40 years of the entire cost of the distribution system of the unit.

Under the contract draft, the annual payment of the construction charge for the distribution system may be based on either of two factors. One is a variable repayment charge governed by the annual returns to farmers from their irrigated crops. The other is a fixed annual charge based on the best estimate of the water users' long-time ability to pay. Either plan would schedule the repayment of the cost of the distribution system within 40 years.

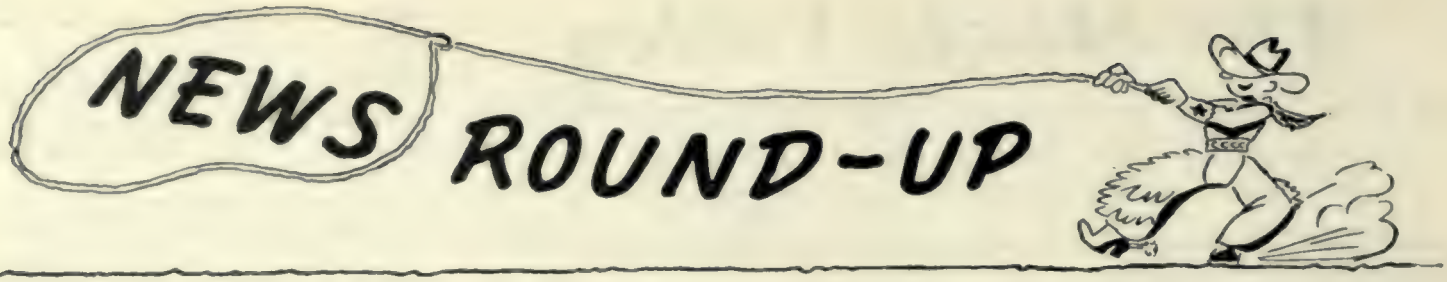
During the contract negotiations the two repayment methods will be fully explained to the boards of directors of the irrigation districts so that the repayment method most suitable to local conditions may be adopted. In addition to annual payments to apply on the construction obligation, the water users will pay annually under this part of the contract the actual costs for operation and maintenance of the distribution system.

The estimated construction costs of the Frenchman-Cambridge unit, which will serve about 54,000 acres in the Republican River Valley of Nebraska and provide flood protection, have increased about 50 percent over the 1940 cost basis set forth in Senate Document 191 on which the Missouri Basin project was authorized by the Flood Control Act of 1944.

The directors of the Frenchman-Cambridge district in July agreed to increase the repayable obligation of the district in ratio to the increased cost. In other words the Frenchman-Cambridge district's obligation has been increased about 1½ million dollars. The repayment arrangements will be negotiated on that basis.

Because of changes in plans, on the Heart River unit (consisting of about 14,000 acres) in west central North Dakota, final estimates of the construction costs are being revised. Indications are that those costs will be considerably in excess of the estimates when the project was authorized, because of changes in plans and increased labor and material costs. The additional or increased obligation the Heart River unit will be expected to assume will be the subject of negotiations when the revised cost estimates of the unit are available.

The Secretary of the Interior has held that the water users' proportionate share of the increased construction costs of Reclamation projects shall be reflected in the repayable obligations to be assumed by water users. He also requires a repayment contract or other satisfactory evidence of the willingness of the water users to repay the reimbursable construction costs before construction of any feature of a project may begin. In the Frenchman-Cambridge case, a resolution of the district board was regarded as satisfactory evidence of the good faith of the water users to enter into a repayment contract, whereupon the Secretary authorized the award of a contract for the construction of Enders Dam. Construction of other features of the Frenchman-Cambridge unit will await execution of the contract. A similar procedure is anticipated on the Heart River unit in North Dakota provided the district water users adopt the same cooperative spirit as shown by the Nebraska district.



Straus Named to World Power Committee

Commissioner Michael W. Straus has been nominated chairman of a committee of five to work with the Commission Internationale in collaboration with the United States Committee of the World Power Conference.

Crops Jump in Gross Value

Crops in eastern Morgan County and western Summit County, in Utah, which in no previous year had produced an income of more than $2,000,000, in 1945 had a gross income of more than $13,700,000—an increase of almost 600 percent. The factor that caused the difference was the Bureau of Reclamation's Weber River irrigation project.

The project cost the Federal Government $2,725,885 to construct—or only one-fifth of the increase in crop values during the first year of operation. The water users in a period of a year will repay to the United States the project's cost.

Record for Hard Rock Drilling

The world's record for driving in granite or hard rock was made by three drilling crews at Rams Horn Tunnel-Colorado Big Thompson project when they drove a total of 80 feet in 24 hours. To make the record official, measurements were taken by Bureau of Reclamation engineers. The operation required 1,925 pounds of powder.

Weed Program Accelerated

The cooperative weed research program undertaken jointly by the Bureau of Reclamation and the Bureau of Plant Industry is now under way with work to start soon in research centers in Idaho and Arizona. A BPI plant physiologist has been working in the Denver Reclamation chemical laboratory. Details of the program yet to be worked out will be based on a recently executed memorandum of agreement between the two agencies. Widespread interest has been expressed in the preliminary edition of the manual of Weed Control on Irrigation Systems. Numerous suggestions for minor improvement in it have been received and the demand for copies including numerous requests from foreign countries is exceeding the supply.

The use of 2–4D on willows and other ditchbank weeds, and Benochlor for waterweeds, in addition to other improved weed control measures recommended by regional weed control specialists, is beginning to show reductions in operation and maintenance costs. The assignment of weed control specialists to each region has proved most satisfactory in developing a comprehensive weed control program covering irrigation systems and project farms.

Klamath Horses Take Trip to Europe

One hundred head of horses raised on the Liskey Bros. Swan Lake range on the Klamath project were recently shipped to Europe. The horses will be used to work in the fields of war-torn Holland, Belgium, Russia, and France. Many of the animals are from the original stock placed on the range by the Liskeys more than 30 years ago.

Straus to Visit Puerto Rico

On the invitation of Gov. Jesus T. Pinero of Puerto Rico, Commissioner Michael W. Straus is expected to visit Southwestern Puerto Rico to confer upon certain aspects of a multiple-purpose irrigation project. The visit is tentatively planned for the first week in February.

Density Current Data Sought

The demand for density current data collected at Lake Mead from 1935 to 1940 still continues. In view of the fact that analyses of these data, by scientists of various Federal agencies in Washington, was interrupted during World War II, plans are now under way to have the material printed and make it available to scientists throughout the world.

F. D. R. Memorial Under Study

A committee of five members of the Bureau's Washington office was recently appointed to study a proposal for proceeding with the plans for developing a structural memorial for the late Franklin D. Roosevelt. The proposed site of the memorial would be at Grand Coulee Dam overlooking Franklin D. Roosevelt Lake.

Bureau Experts In Demand

The latest requests for the loan of the services of Bureau experts in the fields of engineering and irrigation have come from the following countries and territories, through the Departments of State: Korea, Afghanistan, El Salvador, Egypt, and Puerto Rico, China, Costa Rica, Ecuador, Iran, Ceylon, and Hawaii.

Domestic Water From Irrigation Ditches

The Branch of Operation and Maintenance has begun a survey to determine the extent to which domestic water supplies are being drawn from irrigation ditches in all areas under its jurisdiction. The suitability of irrigation waters for drinking purposes, the need for additional studies, and other data on the purity of water supplies on irrigation projects will also be explored.

A Department-wide program concerning pollution of the western water supplies is under consideration by the Water Resources Committee, but no definite action has been taken thus far.

Pollution problems will be considered in the planning of future projects and, wherever it seems pertinent, the suitability of water for domestic and industrial uses will also be determined.

Columbia Basin Meeting Scheduled

Development of the Columbia River Basin will be the subject of a meeting of the Northwest States Development Association tentatively scheduled for March. The Association is comprised of Gov. Sam Ford, of Montana, chairman, and the governors of Idaho, Oregon, Washington, and Wyoming.

Renewable Natural Resources Conference

The Inter-American Conference on the Conservation of Renewable Natural Resources is scheduled for Yosemite National Park May 5–18. The Department of the Interior Committee on Scientific and Cultural Cooperation is preparing the program. The Bureau of Reclamation, Bureau of Land Management, National Park Service, and Fish and Wildlife Service are the Interior agencies primarily concerned with the conference.

U. S. GOVERNMENT PRINTING OFFICE 1947

Notes For Contractors

Contracts Over $10,000 Awarded by Branch of Design and Construction During December 1946

Spec. No.	Project	Date of award	Description of work or material	Contractor	Contract amount
1411	Fort Peck Power, Mont.-N. Dak. and Missouri Basin-power transmission lines unit, N. Dak.	Dec. 6	Schedules 2, 5, and 8, construction 115-kv. transmission lines, Glendive-Miles City, Fort Peck-Williston, and Williston-Garrison (aluminum conductors).	Morrison-Knudsen Co., Inc., Boise, Idaho.	$3,289,700.00
1456	Klamath-Tule Lake, Modoc unit, Calif.	Dec. 17	Schedules 1, 3, vertical-shaft pumps, pumping plant D.	Fairbanks, Morse & Co., Kansas City, Mo.	22,594.00
1466	Colorado-Big Thompson, Colo.	Dec. 19	Schedule 1, three 21,000-hp. vertical-shaft turbines, Estes power plant.	Allis-Chalmers Mfg. Co., Denver, Colo.	525,800.00
		...do....	Schedules 3 and 6, three 16,667-kv.-a., 1 9,000-kv.-a. generators, field tests; spare parts c, d, e, and h for each schedule, Estes and Mary's Lake power plants.	General Electric Co., Denver, Colo.	606,103.00
		...do....	Schedule 4, 1 11,300-hp. vertical shaft turbine, Mary's Lake power plant.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	160,000.00
1481	Columbia Basin, Wash..	Dec. 10	4 833 kv.-a. transformers, 1 15,000-v. disconnecting switch, 3 15,000-v. disconnecting fuses, 6 lightning arresters, Pasco pumping plant.	Westinghouse Electric Corp., Denver, Colo.	18,709.95
1483	Boise-Payette, Idaho...	Dec. 11	Preparation concrete aggregates, Keener deposit.....	Utah-Idaho Concrete Pipe Co., Nampa, Idaho.	29,200.00
1494	Colorado-Big Thompson, Colo.	Dec. 4	8 vertical-shaft pumping units, Colorado River improvements, Kremmling area.	Fairbanks, Morse & Co., Kansas City, Mo.	11,144.00
1496	Davis Dam, Ariz.-Nev..	.....do..	Item 1, 5 stop-log guides, Davis power plant intake structure.	Willamette Iron & Steel Co., Portland, Oreg.	38,741.00
		Dec. 17	Item 3, 2 stop-log guides, Davis Dam outlet structure..	Valley Iron Works, Yakima, Wash.	43,800.00
1518	.....do.....	Dec. 24	Erecting 20 2-bedroom prefabricated houses, Davis Government camp.	W. S. Ford, Kingman, Ariz.....	47,900.00
1535	Central Valley, Calif....	Dec. 30	Structural steel for S. P. Railroad bridge and farm bridges, Westley wasteway, Delta-Mendota Canal.	American Bridge Co., Denver, Colo.	17,117.00

Invitations for Bids for Construction and Supplies, in Amounts Over $10,000, Expected To Be Issued by Branch of Design and Construction During February 1947

Project	Description of work or material	Estimated date bids to be invited	Estimated bid opening date
Davis Dam, Ariz.-Nev.....	20-ton machine shop crane, Davis Dam and power plant.....	Feb. 1	Mar. 8
Provo River, Utah.....	5-foot, 9-inch by 8-foot, 0-inch fixed wheel gate frame and hoist, Salt Lake aqueduct, station 0+00 to 296+49.1.	...do.....	Do.
Deschutes, Oreg.....	Earthwork, concrete structures, and steel pipe line, north unit, main canal, station 2994+00 to 3010+50.	Feb. 10	Mar. 18
Boulder Canyon, Ariz.-Nev.....	Motor control equipment for Boulder City supplemental water supply system.....	Feb. 15	Mar. 22
Buffalo Rapids-Second, Mont.....	Motor control equipment for Fallon & Fallon relift pumping plants.....	...do.....	Do.
Colorado-Big Thompson, Colo.....	50- and 70-ton cranes, Estes and Mary's Lake power plants.....	...do.....	Do.
Do.....	50-ton, 25-ton, standard traveling cranes; 15-ton special traveling crane, Granby pumping plant.	...do.....	Do.
Do.....	3 turbine governors, Estes power plant.....	...do	Do.
Do.....	1 turbine governor, Mary's Lake power plant.....	do	Do.
Columbia Basin, Wash.....	Substation equipment and motor control equipment for Pasco relift pumping plants; transformers for R1, R2, R3 generating units, Grand Coulee.	...do.....	Do.
Davis Dam, Ariz.-Nev.....	Transformers for Davis power plant.....	...do.....	Mar. 22
Do.....	Copper cable, insulators, hardware, connectors for Davis switchyard.....	...do.....	Do.
Do.....	Oil circuit breakers, disconnecting switches, Tuscon, Phoenix, Gila, Mesa, and U. S. B. R. Arizona-Edison substations.	...do.....	Do.
Do.....	Main control board, Tucson substation.....	...do.....	Do.
Do.....	Five turbine governors, Davis power plant.....	...do.....	Do.
Do.....	100-ton low platform reversible full trailer with 50-ton jacks, 230-kv. Barker-Gene interconnection.	...do.....	Do.
Hungry Horse, Mont.....	150,000-gallon water tank, Hungry Horse Government camp.....	...do.....	Do.
Missouri Basin-Angostura Unit, S. Dak..	7.74- by 7.74-foot fixed wheel-gate frames and anchorage, Angostura Dam.....	...do.....	Do.
Parker Dam Power, Ariz.-Calif.....	Machine shop for Parker Government camp.....	...do.....	Do.
Yakima-Roza, Wash.....	Construction Yakima pumping plants 13 and 14.....	...do.....	Do.
Davis Dam, Ariz.-Nev.....	Double garage for Davis Government camp.....	...do.....	Do.
Do.....	Garage and filling station for Davis Government camp.....	...do.....	Do.
Do.....	20 permanent residences for Davis Government camp.....	...do.....	Do.
Davis Dam, Calif.-Ariz.....	12 miles 34.5 kilovolt transmission lines, Yuma area improvements.....	Feb. 20	Mar. 27
Colorado-Big Thompson, Colo.....	Penstock air vent and structure drains, Estes penstock gate structure.....	Feb. 25	Apr. 1
Columbia Basin, Wash.....	19- by 17-foot radial gates and hoists, West Canal, bifurcation plant to Soap Lake siphon.	...do.....	Do.
Do.....	13.8-kv. transmission line from Bonneville Power Administration 115-kv. transmission line to Pasco pumping plants.	...do.....	Do.
Colorado-Big Thompson, Colo.....	Construction Olympus Dam, earthfill.....	Feb. 28	Apr. 4
Parker Dam Power, Calif.-Ariz.....	Main control board, Gila substation.....	...do.....	Do.
Davis Dam, Ariz.-Nev.....	Power plant control and auxiliary power equipment.....	...do.....	Do.

Land at Tule Is Drawn by 85 Men, Girl
FARM WINNER LIST
LUCKY VETS DRAW RICH FARMING LAND
First Number To Banks Man; Portlander 3d
Oregon Daily Journal
'GOOD TIMES' DEPEND ON WORK, SAYS TRUMAN
OMESTEAD DRAWING SPEEDY
E. M. Lindsay First Klamath Basin Winner
Herald and News
Wagner Indicted By Grand Jury
Policeman Accused Of Jail Beating
Suspense Rules As First Homestead Number Is Drawn
The Oregonian
KLAMATH FARMS DRAW
10 Children Lose Lives At Crossing
Polio Victim Who Survived Son's Birth Looks Forward to Rougghouse With Lad
VETS WIN RICH SOIL
Banks Man First; Portlander No. 3
Tule Lake Land Winners Tell Future Plans
Four S. F. Veterans Win Farms in Land Lottery
Grand Jury Indictments
SEVERE TESTS STILL TO COME
PLOTS ALREADY IN CULTIVATION
Job, Productio Brightens, S
Flood Drop
Road Conditions Unchanged Today

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MARCH
1947

In This Issue:

IRRIGATION IN THE PHILIPPINES

by
Ambassador McNutt

YAKIMA-TIETON CELEBRATES

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THE *Reclamation* ERA

OUR FRONT COVER

All the world loves beauty

Young Moses Lopez, with a smile that matches the brightness of the chrysanthemums, is a descendant of the Spanish people who practiced irrigation in the Lower Rio Grande Valley hundreds of years ago. Here he obligingly poses in Francis J. Warnock's shipping shed. Warnock's Bureau of Reclamation farm in the Lower Rio Grande Valley produces $100,000 worth of these football season flowers annually. (See p. 58).

Illustration Credits

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Speaking of Credits . . .

The unusually fine drawing of the Hungry Horse Dam which appeared on page 37 of the February ERA was the work of John MacGilchrist of the Branch of Design and Construction in Denver. He is well known for his drawings of the Yangtze George project in China, which received national attention last winter.

Reclamation ERA

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Irrigation in the Philippines

by THE HONORABLE PAUL V. McNUTT

American Ambassador to the Republic of the Philippines

The Philippines is currently engaged in a Nation-wide food production campaign.

In this campaign, irrigation will play a high priority role as this administration recognizes the vital part which this type of agriculture plays in any program of food production, especially of rice (the staple food of four-fifths of the country's 18 million inhabitants).

During enemy occupation, when the price of rice reached prohibitive heights, the hungry citizens of Manila would stealthily run after passing rice trucks, disregarding the armed convoys, and puncture the rice sacks. After the trucks had passed, leaving a trail of fallen grains, they would sweep them up with brooms, and hurriedly rush home with the precious particles of food (mixed with the dirt from the street). Philippine officials and farmers exclaimed then, "If we only had more irrigation systems!"

They are still saying that very thing.

On the food production program, at the top of the list, is the construction of new irrigation projects, as well as the repair and improvement of existing irrigation systems.

About 2 million hectares, or 4,940,000 acres (1 hectare=2.47 acres) are devoted to rice cultivation in the Philippines. Of this, about 30 percent, or approximately 1,482,000 acres, is devoted to irrigation. One-fifth of the irrigated area, or about 296,400 acres, is served by Government-owned irrigation systems, the rest being covered by private systems owned by individual farmers or by communal irrigators.

During the war, irrigation canals, structures and protective dykes were damaged. Field administration buildings owned by the National Government irrigation systems were destroyed, along with valuable equipment for irrigation investigations, construction and operation, which caused the suspension of any construction during that period. Invaluable plans and other records of several Government irrigation projects, most notable of which was the 49,400-acre (20,000-hectare) Pampanga River irrigation project in Nueva Ecija Province, have been lost by burning.

The power to grant appropriation of water for irrigation, as well as for all other public waters, is vested in the Secretary of Public Works and Communications, who decides all water rights applications, adjudications, or controversies, upon the recommendation of the five-man irrigation council appointed by the President of the Philippines.

The administration of National Government irrigation systems, including the levying of irrigation fees, is legally under the President and directly under the Director of Public Works of the Department of Public Works and Communications. Irrigation systems within the Friar Lands Estates, which were purchased by the Government from the Spanish friars, are administered by the Bureau of Lands under the Department of Agriculture and Commerce; these systems embrace about 74,100 acres (30,000 hectares), mostly planted to rice and partly to sugar in the Provinces of Cavite, Laguna, Rizal, and Bulacan. Private irrigation systems are owned and operated by the owners of irrigated lands, except those few systems administered by unique organizations called the "zanjeros" (ditch owners), which have existed since the Spanish regime. In a "zanjero" irrigation system, the "zanjeros" operate and maintain the irrigation system, although they do not own the irrigated lands. For irrigation services, the "zanjeros" are allowed by the landowners to cultivate and appropriate the produce of part, usually one half, of the irrigated land while the landowners are served water free for the other half; or the landowners cultivate all the land and turn over one-half of the produce to the "zanjeros." The "zanjero" irrigation systems exist principally in the Province of Ilocos Norte; the landowners there agitate constantly for the abolition of the "zanjero" practice.

Acknowledgment

I am deeply indebted for assistance in the preparation of this article to Mr. Isaias Fernando, Director of the Bureau of Public Works of the Philippine Government. Director Fernando has kindly furnished me with all the facts and background concerning irrigation in the Philippines, bringing to this task the interest and knowledge which is his as a pioneer in the field. A great deal of what has been done in Philippine irrigation is the result of his work. This article could not have been prepared without his assistance and cooperation.

PAUL V. McNUTT

The Bureau of Public Works is responsible for the investigation, preparation of plans, construction, and operation of Government irrigation projects. The Government proceeds with the construction of an irrigation project, once determined as advisable, unless the owners of one-half of the irrigable land or three-fourths of the owners of such land under the project file their objection against such construction within 90 days following due public notice.

All Philippine Government irrigation systems are of the gravity type, with water diverted directly from rivers by means of low overflow dams, without any supplemental supply from storage reservoirs. Typical diversion works consist of a weir connected to a long apron, with the crest of the weir usually less than 3 meters above the downstream floor. Steel sheet pile cut-off walls are provided on the upstream toe of the dam and at the downstream end of the apron; adjoining the apron downstream are several rows of staggered concrete blocks. Scouring sluiceways are provided at the end of the dam adjoining the main canal headworks. Carrying capacities of canals and structures are computed on the basis, generally, of one and one-half second-liters per hectare (0.021 cubic foot per second per acre) of irrigable area. All canals are of ordinary earth. No concrete-lined irrigation canals have been constructed so far. All structures, however, from the main canal headworks to the smallest turn-out are of concrete, mostly reinforced.

Irrigation was practiced in the Philippines long before the arrival of the Spaniards. Centuries ago the colossal task of converting an estimated area of 61,750 acres (25,000 hectares) of mountain sides into highly productive rice terraces—incidentally, one of the wonders of the country—was accomplished through the ingenuity and persistent labor of generation after generation of non-Christian tribes in northern Luzon. During the Spanish regime, another notable achievement in irrigation development was the construction of irrigation works, involving study and labor of about a century, to serve the vast land holdings of the friars in the Provinces of

Laguna, Cavite, Bulacan, and Rizal, embracing a total area of about 74,100 acres (30,000 hectares).

The policy of constructing irrigation systems by the Philippine Government was started in 1907 when it appropriated a reimbursable sum of 250,000 pesos for the investigation and construction of irrigation projects. In 1908 further legislation provided for a permanent annual reimbursable sum of 750,000 pesos for irrigation construction. The first major project built by the Government was the San Miguel irrigation system in Tarlac Province for the irrigation of 14,620 acres (6,000 hectares) of rice and sugar lands of the Tabacalera, a private corporation, at a fixed annual irrigation fee of 29,000 pesos. The funds for irrigation construction were withdrawn by the Government during the 4 years of the first World War due to retrenchment. The construction program was resumed in 1918 and it received substantial encouragement in 1922 when proceeds from the sale of a 20-million-peso bond issue was authorized for irrigation construction.

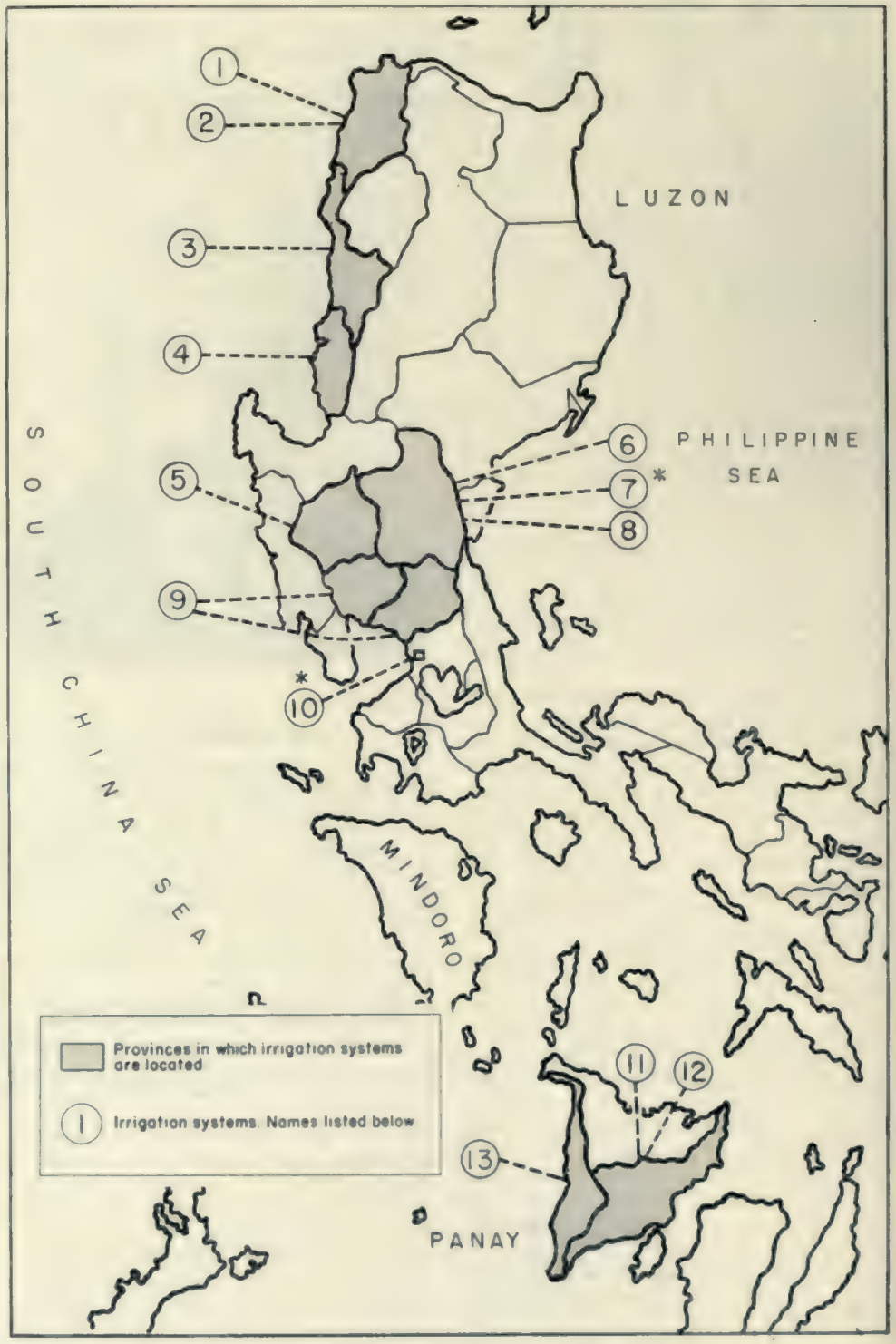
The 20-million-peso bond issue was originally intended to be the anchorage of a revolving fund for the widespread and continuous construction of irrigation systems in the Philippines. Each irrigation system constructed with money derived from this fund was supposed to be able to redeem the cost of construction at the end of 20 or 40 years through revenue from irrigation charges.

These charges, varying with the cost of construction, consisted of (*a*) the cost of operation and maintenance of the systems; (*b*) an amortization charge estimated to pay off the capital invested in construction at the end of the period specified in the irrigation notice published before the actual construction of any system, and (*c*) a contingency charge to take care of unforeseen major repairs. The annual irrigation charge varied in the different systems from 9 pesos to as high as 22 pesos per hectare of irrigated area.

The system of amortization was adopted with the object of turning over the ownership and operation of the system to the landowners at the end of the 20- or 40-year period, as the case might be, after the money invested in the construction of the system had been fully recovered by the Government and made available for use in the construction of other irrigation projects. This policy was carried for several years, and resulted in the construction of 11 irrigation systems. During the enemy occupation two small systems, the Rizal system at Nueva Ecija, and the Hanagdung system at Quezon, were constructed of semipermanent materials. (See map above.)

At first, the collection of irrigation charges was very satisfactory, and the Government laid out a scheme for a wide irrigation coverage of Philippine agricultural lands. For various causes, the collection of irrigation charges dropped perceptibly in

PHILIPPINE IRRIGATION SYSTEMS



1. Dingras Irrigation System (2,594 acres), Ilocos Norte Province.
2. Laoag-Vintar Irrigation System (5,434 acres), Ilocos Norte Province.
3. Tagudin Irrigation System (3,211 acres), Ilocos Sur Province.
4. Amburayan River Irrigation System (9,139 acres), La Union Province.
5. O'Donnell River Irrigation System (8,225 acres), Tarlac Province.
6. Penaranda River Irrigation System (42,904 acres), Nueva Ecija Province.
7. Rizal Irrigation System (2,470 acres), Nueva Ecija Province.
8. Talavera River Irrigation System (22,526 acres), Nueva Ecija Province.
9. Angat River Irrigation System (64,097 acres), Bulacan and Pampanga Provinces.
10. Hanagdung River Irrigation System (667 acres), Quezon City.
11. Santa Barbara Irrigation System (11,461 acres), Iloilo Province.
12. Aganan River Irrigation System (13,991 acres), Iloilo Province.
13. Sibalom-San Jose Irrigation System (10,868 acres), Antique Province.

*Constructed of semipermanent materials during the enemy occupation.

Preparing the ground for planting rice.

1929 and has since continued to do so. Delinquencies in the payment of irrigation fees and the consequent court actions for collection mounted, resulting in a series of amendments to the original Irrigation Act of 1912.

The most important amendment, in effect, abandoned prospective ownership of the systems by the landowners, and changed the amortization charges to uniform flat assessment fees; the annual payments by the landowners being pruned to a maximum of 12 pesos per hectare in 1929, then to 6 pesos per hectare in 1935, the ownership of the systems being retained permanently in the Government. In spite of these relief acts of the Government, collection of the reduced rate continued to be unsatisfactory.

In 1936, the administration of Government irrigation systems was placed in the hands of the President, who was authorized to fix the irrigation charges and to prescribe the manner of payment. The construction of Government irrigation systems was sidetracked in 1932 by diverting the balance of over 4 million pesos realized from the original bond issue to other public works projects, but in 1935 an equal amount was appropriated for irrigation.

Before the war, with common labor available at a daily wage of one peso or less, the 6-peso fee was barely sufficient for the operation and maintenance of the systems, not to mention the annuity required to amortize the cost of construction.

With ditchtenders and other laborers in the irrigation systems today getting twice the prewar wage or higher, it is no longer possible to operate these systems satisfactorily with funds derived solely from irrigation charges at the prewar rate.

On July 22, 1946, because of the high cost of operation and maintenance of the systems, President Roxas fixed the annual irrigation fee on Government-owned systems at 12 pesos per hectare.

Land ownership within the Government irrigation systems is generally in small holdings, the average for all the systems being 7.2 acres (2.9 hectares). Land holdings are particularly small in those systems located in the thickly populated Ilocos Provinces, namely; the Laoag-Vintar, the Dingras, the Amburayan River and the Tagudin irrigation systems, where the average farmer owns only 1.5 acres or six-tenths of a hectare. In Central Luzon, the average holding ranges from 13.8 acres (5.6 hectares) in the Angat River system to 22.2 acres (9 hectares) in the Talavera River system. The O'Donnell River irrigation system in Tarlac Province has an exceptionally high average—64.2 acres or 26 hectares per landowner. In the systems located in Panay Island, the averages are 5.93 acres (2.4 hectares) for the Sibalom-San Jose, 8.15 acres (3.3 hectares) for the Aganan River, and 16.55 acres (6.7 hectares) for the Santa Barbara irrigation systems.

The systems are built in accordance with the irrigation law chiefly to assure the rice crop during the regular growing season, which in most places starts with seedbed preparation in May or June and ends with the harvest in December and January. The short-season variety is harvested as early as October.

In some systems, where rice is also planted during the dry season when the water supply can irrigate only a fraction of the irrigable area, the system is divided into zones, one zone at a time being given water during the dry season of the year. In most systems, however, rice is not grown during the dry season, especially in central Luzon where the largest Government irrigation systems are located.

One of the main reasons for this practice is the farmers' persistent adherence to their old practice of growing only one "successful long crop" in one year, followed by an allegedly much-needed rest for them and for the soil during the remainder of the year. In many other places, however, the "rest" consists in planting crops other than rice, principally mongo, tobacco, corn, tubers and vegetables.

The average production within the systems is from 45 to 50 "cavanes" of "palay" (palay is unmilled rice; one cavan of palay weighs 97 pounds) per hectare, although production of over 65½ bushels per acre (100 cavanes per hectare) had been reported from a few places previous to the war. In 1945, the highest rate reported was about 61¾ bushels per acre (94.5 cavanes per hectare).

It is conservatively estimated that in one regular irrigation season alone, that is, not counting the production during the dry season, one hectare of land within the Government systems yields an average of 20 cavanes (or 32 bushels) of palay in excess

Teaming up in rice planting season.

of that harvested from the same area of unirrigated land adjoining the systems.

Before the war, with the low price of rice, the 6 pesos paid by the landowners as irrigation fee to the Government represented the equivalent of over 2 cavanes of palay, or 10 percent of the average difference in production between irrigated and unirrigated lands.

Today it takes only 1 cavane of palay, or 5 percent of the excess production attributable to the irrigation service, to cover the new 12-peso irrigation fee.

The success or failure of farms within Philippine irrigation systems is dependent upon many factors other than the proper supply of water. Farm difficulties being experienced at present may be considered either as being inherent, or as an aftermath of the war.

Considerable damage to crops due to rats and insect pests is reported annually from almost every system, resulting not only in direct loss to the farmers themselves but also in the noncollection by the Government of irrigation fees from the areas so affected. It is sometimes difficult to convince some farmers to pay proper attention to seed selection, weeding, and use of fertilizers. Incidentally, Filipino farmers maintain that weeds in rice fields are kept down by continuous submergence of the field.

The effect of indiscriminate slaughter of farm animals during the enemy occupation is now greatly felt in every area. Unsatisfactory conditions of peace and order since the end of the war, coupled with deep-rooted conflicts between landlord and tenant, have brought about farm difficulties more serious than those caused by purely scientific problems still unsolved. Planting in some places has been unduly delayed or entirely discouraged.

Transplanting the rice from seed bed to the fields.

Absentee landlords have increased in number. The administration of irrigation systems has become more complex with the passage of the new tenancy law which provides among other things, that wherever the 70–30 crop sharing ration (70 percent of the harvest to the tenants and 30 percent to the landowner) is enforced, the payment of irrigation fees is charged against the tenants.

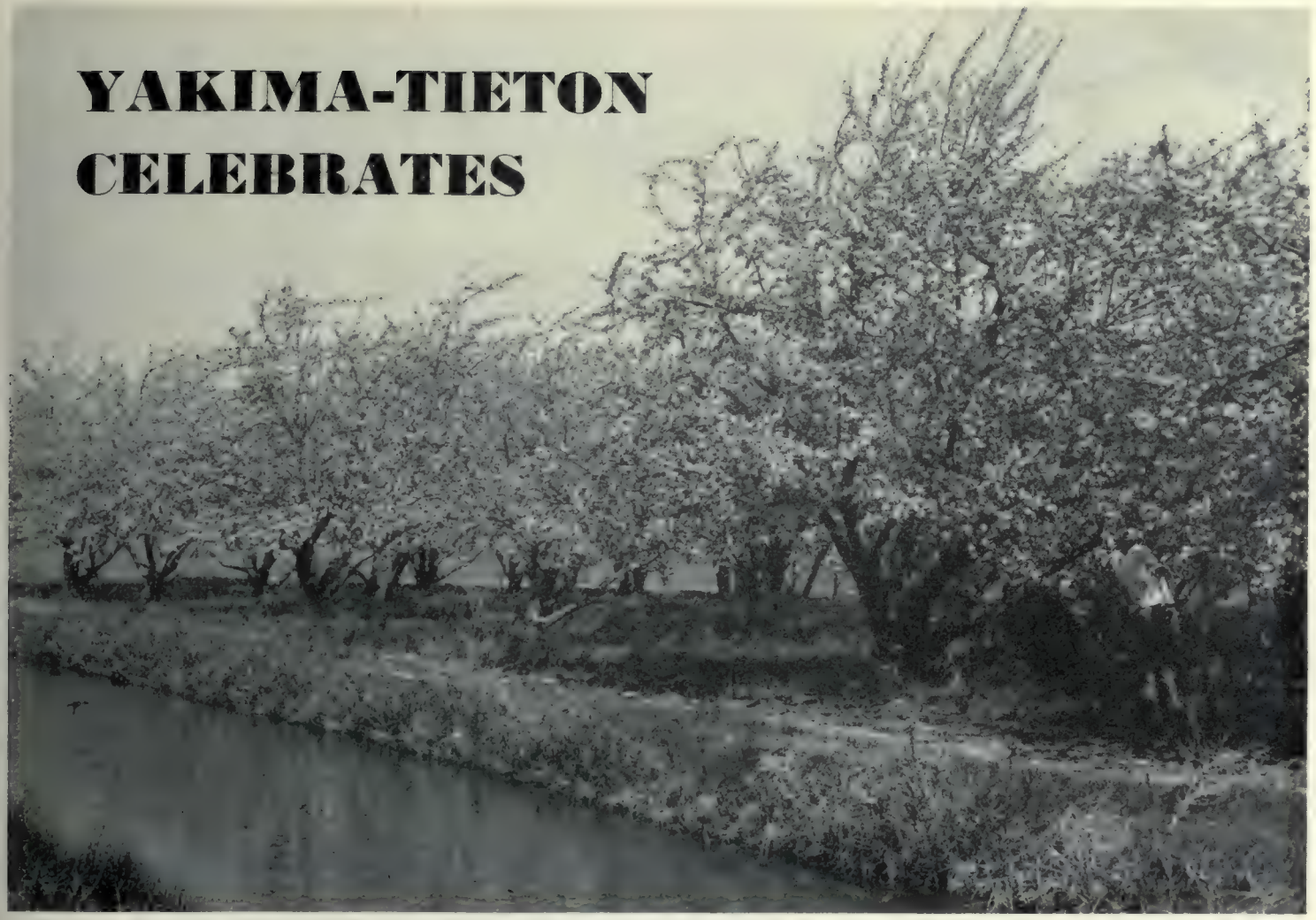
Public interest in irrigation construction, which may be said to have gained momentum steadily since 1908, began to wane in 1929, reaching its lowest ebb during the depression years of the early thirties. It started to pick up again in 1938 when, for the first time in Philippine legislative history, a few members of Congress assigned their shares of public works entirely to irrigation projects in their respective districts, instead of splitting them into the usual insignificant amounts for barri (district) roads or schoolhouses.

After the liberation of the Philippines, a substantial amount was included in the emergency public works appropriation for "reopening" the Philippine Government irrigation systems. Then in July 1946, supplementing his many pronouncements in

(*Continued on page 54*)

Typical of Philippine rice culture are these terraced paddies in the province of Camrines Sur.

YAKIMA-TIETON CELEBRATES



When reclamation farmers finish paying the construction costs of an entire irrigation system, they and the Nation have reason for pride

In May 1910 water started flowing from a new canal across the slopes of the Tieton bench in the Yakima Valley of Washington. It coursed along newly dug laterals and ditches and soaked into the land. Crews of workers planted young trees, and seeded for crops, expectantly awaiting the day of harvest. The new Tieton division of the Yakima Valley project, long the hope of early settlers, at last was in operation. It was one of the first projects of the rather new Federal agency, the Reclamation Service, now the Bureau of Reclamation, which had been established under the Reclamation Act of 1902.

Thirty-seven years passed. On St. Valentine's Day in 1947, survivors of the first water users, and the many who came after them, gathered at the thriving city of Yakima to the south for a very special celebration. This also was something new, for it was in observance of the complete repayment by the Tieton district farmers of the $3,580,000 which was spent to build the irrigation system which now serves 25,000 acres of highly profitable agricultural land. Tieton is the first irrigation district to complete the repayment of construction costs to the Reclamation fund.

The celebration at Yakima on February 14 was significant not only for this very praiseworthy accomplishment of paying off all charges. It also symbolized the investment value of reclamation. Since 1910 the Nation has been richer by $157,000,000 from Tieton-produced crops. This represents 45 times the cost of constructing the irrigation works. The products of Tieton's orchards are known the world around, and yet many other crops are grown.

Dignitaries gathered to mark the observance. Secretary of the Interior J. A. Krug, Governor Mon C. Walgren of Washington, Senators Harry Cain and Warren Magnuson, and Congressmen Hal Holmes and Walt Horan were among the principal visitors invited to attend. The Tieton farmers, led by Clifford Kail, chirman of the Yakima-Tieton irrigation district, were the centers of attraction both at the banquet and at a mass meeting which followed.

Tieton is one of the three main divisions of the Yakima project now completed and operation. A fourth, the Roza division, is under construction. The 1,300 farms on the Tieton division average about 24 acres to a farm. During 1946, the average return on Tieton lands was $751 per acre, a right fair profit on land which once, before irrigation, could be had at $1.25 an acre.

Repayment of the water users' contract gives the Tieton ranchers the right to operate and maintain the irrigation works. The Bureau of Reclamation will turn over these functions as soon as necessary contractual procedures are completed.

The achievement of Tieton ranchers culminated hopes of the first settlers in Yakima Valley. As early as 1890 irrigation was under way in the area, but the full development of the land and water resources was not planned until the Reclamation Act of 1902 paved the way for the Federal Government to assist the settlers in irrigation developments. Surveys in 1905 were followed by approval of the irrigation plan for the Tieton division in 1906.

Construction was a difficult proposition. The Tieton Canyon could be reached only by pack train, and private contractors shied from the construction proposals which were

Tieton district farmers VOTE their way out of debt.

advertised and readvertised. As a result, the bulk of the irrigation system was constructed by Government forces. Water was first furnished in 1910, but since storage was not available that summer, the supply was shut off in August. The following year, however, regular water deliveries were made for the entire season. With availability of water, Tieton land prices rose sky high, prices reaching $500 an acre. The price leveled off afterward, partly through operation of antispeculation regulations.

New settlers flocked to Yakima from every State of the Union. Not many of the newcomers were farmers. They included doctors, lawyers, druggists, hardwaremen, school teachers, and professional men of all types. Despite the lack of farm experience, a surprisingly large number were successful, building their own roads, schools and churches, and irrigating their land to a point of high productivity.

Apples, peaches, pears, prunes, small fruit such as berries, cherries, grapes, and plums are the principal crops. Hops, sugar beets, cereals, hay, and forage are also grown.

The construction costs of the Tieton division ranged from $93 to $100 per acre. And they have been met, to place Tieton division at the head of the list of irrigation districts meeting their reclamation obligations in full, and on time.

Yakima Superintendent Ball displays "pride of Tieton's eye" for new District Board members Fred C. Beisner, Clifford Kail (President), and H. R. Praetorius.

Irrigation in the Philippines

(*Continued from page 52*)

favor of irrigation, President Roxas wrote a Congressman relative to the latter's query about a proposed irrigation project in his Province, ". . . I also realize that the construction of irrigation facilities will increase the rice harvest and thus contribute to the economic progress of the Province. I am giving top priority to Government projects designed for agricultural development, a priority even above that usually assigned to road-building projects."

In connection with the food production campaign, the Secretary of Public Works and Communications has directed that at least one engineer in every engineering district devote his time exclusively to irrigation activities.

The Public Works Appropriation Act passed by the last Philippine Congress set aside 18,000,000 pesos for the irrigation activities of the Government.

It is indeed safe to say that the Philippines is now irrigation-minded and it is expected that this attitude will stay. Many Philippine landowners and farmers are clamoring for irrigation during the dry season, urging the construction of storage reservoirs.

The Philippines is looking forward to the day when the construction of multiple-purpose projects—irrigation combined with hydroelectric power and flood control—will be a reality.

EDITOR'S NOTE: Photographs used in the foregoing article were taken by members of the United States Agricultural Mission during their survey of the Philippines last year. The Department of Agriculture plans to release the Mission's report next month.

Nueces River Basin Plan Abandoned

Secretary of the Interior J. A. Krug recently approved the Bureau of Reclamation's recommendation against seeking congressional authorization for Reclamation development of the Nueces River Basin and adjacent Baffins Bay coastal area in Texas.

In his recommendation Acting Commissioner Warne of the Bureau of Reclamation cited the high costs under present construction schedules and the farmers' inability to repay their proportionate share of these costs. Compared with 1940 prices the development would cost 64 percent additional under present costs, or $81,500,000 now as compared with the former estimate of $49,559,000.

Another objection raised by Acting Commissioner Warne was the fact that it appears impossible to develop hydroelectric power to absorb part of the cost.

This finding was based on the fact that the proposed dams in the Nueces development were too low and the water yield inadequate to provide for the generation of hydroelectric power.

DITCHBANK PASTURING

by **Robert B. Balcom,** *Agronomist, Branch of Operation and Maintenance*

Every irrigation district has a ditchbank weed problem. The many methods which have been devised to combat ditchbank weeds show that they create operation difficulties and maintenance costs and are considered one of the major obstacles to the efficient operation of the distribution system. All of the methods tried and numerous studies made have centered around finding more economic methods of solving this problem.

It is gratifying, therefore, to report that now some projects are solving their weed problems in a way which not only gets rid of weeds economically and prevents future weed problems, but also creates additional wealth for the project farmers. It is not a complicated formula involving large annual expenditures for costly materials and equipment, but a simple, practical, inexpensive method which can be easily followed by nearly all irrigation districts.

This method is the pasturing of ditchbanks with livestock. To obtain a full realization of the over-all problem which ditchbank weeds create, you have to consider the numerous costs and losses involved.

When the average project farmer thinks of ditchbank weeds, he realizes the danger of their spreading to his irrigated fields. Perhaps not as many weed patches are started by this means as was formerly thought, but the seeds of certain plants—both annuals and perennials—may be carried considerable distances by water. Weed seeds originating from plants growing on ditchbanks, and accumulating in the bottoms of the channel while the water is out, may be washed into fields with the next run of water. In channels having comparatively smooth bottoms, seeds may also be rolled along the bottom by the water currents.

Winds may carry the seeds of noxious weeds, particularly light seeds with parachute attachments like the Canada and sow thistles, from ditches to cultivated land. Even comparatively heavy seeds are driven over frozen ground, packed snow and ice by winter winds. Both domestic and wild animals scatter weed seeds because many of them pass through the digestive tract unharmed. Seeds with barbs and hooks and those which become mucilagenous when wet are carried on feathers, hair, and clothing. Perennial weeds do not respect property lines and may spread from a ditchbank to adjacent fields by their creeping lateral roots.

Weed Damages Mount

When the irrigation district official thinks of ditchbank weeds, he considers the operation problems and maintenance costs which they create. Trees, willows, and woody shrubs use thousands of gallons of water which may be badly needed for crops. Such woody plants prevent the maintenance of roads and proper inspection of the ditches and if not completely controlled must be removed periodically to make channel cleaning possible. Tall annual weeds grow out or fall over into the water and must be removed so they do not obstruct the flow of water or collect silt. Weed growths also cause unsightly appearance of ditches and cannot help but reduce community pride.

Some projects have proved the economy of pasturing ditchbanks for weed control. In any event the possibility should not be ignored or even passed over lightly by projects which have not given the practice a thorough trial.

When noxious weeds, so costly to eradicate on crop land, and the numerous annual and biennial weeds which hinder efficient farming operations have been controlled on ditchbanks and further infestation prevented, one source of farm weeds has been eliminated. Pasturing will not kill noxious weeds, but it will keep perennial plants from spreading their roots so quickly. In some cases, pasturing will furnish weed-seed control and will keep the banks from being reinfested.

A program of noxious weed control with the new 2, 4–D formulations or other chemicals should be initiated in conjunction with the pasturing program. Poisonous weeds such as water hemlock and whorled milkweed should be eradicated before pasturing is started.

However, after the noxious and poisonous weeds are once eliminated it would be poor economy not to try to develop some means of preventing further infestations. If you do not, noxious weed control on ditches may become an annual maintenance problem. Pasturing eliminates competition from annual weeds and allows the grasses to spread. As these develop into a sod they not only furnish more herbage but reduce the chance of weed seeds coming in contact with the soil. If a weed seed does become lodged where it can germinate, the competition from the grasses and the livestock eating the tender shoots prevent the weed plants from becoming well-established and getting down to the business of causing trouble.

The wrong way! Salt cedars and willows are double threat to ditchbank and surrounding farm land.

The right way! Seeded with crested wheatgrass, this ditchbank offers opportunity for future pasturing.

Every irrigation district is interested in reducing its maintenance costs. Until the pasturing practice is well established and the native or seeded tame grasses have covered the ditch right-of-way, some mowing may be desirable. But once a pasturing program is well under way, you can almost forget about mowing, burning weeds, and grubbing willows. Willows can be eliminated by grazing, but if large, old growths are present they will be killed much sooner if they are first cut down. Livestock prefers the new tender regrowth.

The elimination of weeds and woody plants and prevention of further growths will conserve irrigation water which otherwise would have been lost through transpiration. The neat appearance of grazed ditchbanks stands out in sharp contrast to jungles of weeds prevalent on unpastured sections. Rodents which live on weed and tree roots do not frequent pastured ditches. Also, gophers and ground squirrels do not like to burrow on soil tamped down by livestock.

Perhaps one of the main reasons why ditchbank pasturing has met with such great favor among project farmers has been that the very means of reducing their operation and maintenance costs and weed prevention on crop land has given them additional income.

When weeds are mowed, burned, grubbed or treated with chemicals year after year, you only get the satisfaction of temporarily eliminating the weeds. But when livestock is put to pasture on weed banks, these otherwise waste areas are converted into a profitable supplementary pasture and the weeds are controlled and prevented at much less cost than other methods.

Enthusiastic reports have come from several sections of the irrigated West showing how farmers have been able to support more livestock by utilizing ditchbank pastures. Many have used these grazing areas for dry cows, calves, horses, colts, or several head of sheep. While pasturing with horses is not favored in some areas, all classes of livestock except hogs have been used. Hogs should not be permitted on ditchbanks because of their rooting habits. Horses like to swim and wade in the ditches, and their sharp hoofs may damage banks cut through light soils, or those unprotected by sod.

One important precaution must be taken. You have to control ditchbank grazing as efficiently as any other well-managed pasture. If overgrazed, bare areas and eventually new crops of weeds will result and the entire purpose of the practice will be defeated.

White top on this ditchbank offers a constant menace.

Fence them in—Stock guards save ditch riders' time.

In most areas you may have to fence the ditchbank for pasturing. The use of electric fence has greatly reduced these costs. Cattleguards, to save the ditchriders' time in opening and closing gates, are also desirable. Many farmers who have ditches with too small a right-of-way to pay to fence are still taking advantage of the ditch area by setting the fence back on their property for a short distance.

Another practice which is growing in popularity is the placing of semipermanent pastures adjacent to the irrigation ditches and drains passing through the farm unit. Many irrigation districts have found ditchbank pasturing so valuable in reducing their weed control costs that they have assisted the farmers and created more interest by furnishing all or part of the fencing and cattleguard materials.

A few reasons for not pasturing ditchbanks have been advanced by irrigation districts which have not given the practice a thorough trial. No doubt some of them have some foundation.

For example, in sections of a project where irrigation water is used for culinary purposes it is not difficult to realize the desirability of excluding animals from the ditches.

Claims have also been made that heavy animals tramp loose fills and unsodded stretches into the water section. However, projects which have established an extensive pasturing program state that the small amount of damage which may occur is greatly overbalanced by the good results and general lower costs.

As most of the bank damage is caused when animals go down to the water for a drink this may be partially overcome by digging a sloping ramp in the cut side of the ditch or in a section where the bank is sufficiently wide to accommodate such a ramp. The animals soon learn to use this more gradual slope.

Several projects have increased the forage value of ditchbank pastures by seeding tame grasses. Also, if livestock is withheld from grazing until these seedings have formed a good sod, damage to the banks is prevented or greatly reduced. In the few areas where pasturing is not feasible, low-growing tame grasses may be seeded to replace weed pests. Many projects are seeding new ditches as soon as they are constructed in order to take advantage of the seed bed thus formed and to establish a desirable cover before weed competition develops. This will help stabilize the banks and prevent erosion, and a good pasture rather than weeds will be available for the new project farmers.

The irrigated areas in the West are in general becoming more weed conscious. Irrigation officials, boards of directors, and project farmers realize more than ever before the necessity and desirability of controlling and preventing weed infestations. They have ample proof that ditchbank weeds may infest farm land, increase labor costs, impair the efficiency of canals, laterals and drains and cause numerous other operation problems and maintenance costs.

Occasionally uncontrollable losses occur on irrigation districts which makes it all the more important that everything possible be done to reduce the controllable losses to a minimum. For this reason project officials and farmers who have made a thorough study of ditchbank pasturing and have given it a comprehensive trial refuse to go back to more expensive and less profitable methods of ditchbank weed control.

Weed Warrior

An effective device for removing Russian thistle weeds from irrigation canals has been devised on the Roza division of the Yakima project.

It consists of two extension teeth which are attached to the bucket of a truck-mounted dragline and operated on the bank as a fork. When weeds "jam" in a canal, the pressure of the water on the face of the "jam" oftentimes packs the weeds so tightly that they can be walked on without difficulty. For working out the plan, Harry J. Whetmore, Bureau watermaster, and Ray R. Johnson, dragline operator, each won an award of honorable mention and $50 in cash under the Interior departmental suggestion system.

Each of the extension teeth was made from two pieces of steel, 5/8 inch by 2½ feet by 3 feet 1 inch in size. The two pieces of steel for each tooth were fitted over a dragline tooth so that they met at the point of the tooth and were welded together from the point to the end. The end of each tooth was pointed for about 2½ inches. Holes were drilled and bolts inserted through the straps, the bucket teeth, and the bucket itself. Thus the extensions were held and strengthened by the regular bucket teeth. The teeth extend 24 inches beyond the bucket.

The device has been very practical on the Roza division in all respects except that each time it was connected to the bucket, the bolts holding the bucket teeth had to be cut off. While excavating rock, the bolt threads became so damaged that the nuts could not be unscrewed.

It was therefore suggested that the teeth be made from 4- by 4- by ¾-inch angles about 3 feet long and pointed at the end for about 8 inches. These teeth could be bolted in the corners of the bucket where the bolts would not be damaged while digging weeds. The extensions could be readily attached or removed. It is believed the three ¾-inch bolts spaced at about 5 inches and of suitable length to pass through the angle and the bucket would give ample strength to the device.

Boulder Sets Power Mark

Boulder Dam and power plant which reached its tenth anniversary of commercial power generation, holds the record as a power producer among reclamation projects. By December of 1936, 3 months after the initial unit went into operation, it had produced more than 118 million kilowatt-hours of energy and by the end of 1946 had produced a grand total of 37,251,362,000 kilowatt-hours. That amount would have been adequate to provide all the energy used by the city of Chicago for a period of almost 7 years.

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Money-Making 'Mums

On the Bureau's Rio Grande project, chrysanthemums bring $100,000 a year to the Warnock family

by Lloyd E. Mulligan, *Region V, Amarillo, Tex.*

'Mum is the word on the 135-acre irrigation farm of Mr. and Mrs. Francis J. Warnock at Ysleta, Tex., in the lower end of the Bureau's Rio Grande project.

'Mum—as if you didn't know—is the florist's name for chrysanthemum—the flower so extraordinarily popular with female football fans.

A horticulturist since high school days when he specialized in growing sweet peas and similar small species of flowers, Warnock later switched to chrysanthemums exclusively because of their increasing popularity and attractive commercial possibilities. His specialization in the elegance of the rainbow's flower pot began 20 years ago, and has expanded annually to meet increased demands from florists throughout the Nation.

Warnock is assisted by his wife in the planting, cultivation, marketing and continual effort to increase the pulchritude of the elegant 'mums and the women they adorn. They now devote 16 acres of their fertile irrigation farm to production of 'mums and receive $100,000 annually for their effort. The Warnock-'mum combination is an exceptional illustration of what the Bureau's reclamation program can mean to western farmers.

From the time the rooted divisions of cuttings are planted in early April until the crop is harvested and shipped in the fall, the Warnocks and their small army of floriculturists and common laborers are as busy as bees. The Warnocks use a rooted division for plantings, in contrast with most growers, who prefer rooted cuttings. The roots are started in the three hot houses. Each of the two largest buildings spreads over eight acres. A 2-acre structure is maintained for experimental purposes.

When the rooted divisions begin to grow they are transplanted to open fields and irrigation is applied. As the flowers begin to bud, wooden stakes are driven into the soil to help support the stems. Skilled workmen tour the plants daily to clip off numerous small buds, thereby allowing all of the nourishment to flow to a single bud, thus producing the one large, elegant blossom that goes to market.

As the flowers approach the blooming stage, cloth houses are constructed to shelter them from wind and the wilting, color-destroying rays of the sun. The houses also provide some protection from insects, which seem to receive special bulletins about the progress of the growth of the 'mum crop. The Warnocks, however, keep their eyes peeled for the first sign of insect armies and meet them on the field of battle with modern apparatus and bug-bumping insecticides. When the grasshoppers arrive, the Warnocks call upon their turkey division to gobble up every hopper in sight.

The hot houses, consisting of wooden frames of two-by-fours, covered on tops and sides with white cotton sacking, allow the Warnocks to control the blooming dates of the 'mums to correspond with market demands.

The flowers are irrigated once a week during the summer. However, the period is extended to every 15 days with the coming of fall.

Harvest-time begins in October. Floral workers use a sharp knife for cutting the stem in a downward, slanting stroke, which prevents breakage in the stem and allows for better water storage in the flower.

The cut flowers then are taken into the packing house and placed in water-filled metal containers, where they remain until packed for shipment. 'Mums are so heavy that they have to be protected from themselves while in transit. They are placed in large cardboard boxes and lie on layers of wadded paper, which form a cushion. Wooden wedges are inserted in the shipping boxes to support each layer of flowers and distribute the weight evenly, thus preventing shifting or crushing. Six dozen large 'mums, or eight dozen small ones, are packed in each box. In order to insure moisture, ice is placed in each box prior

to shipment by railway express. Under normal conditions, the 'mums remain fresh in transit from 4 to 10 days without additional refrigeration.

Frost and high winds generate the most anxiety for the Warnocks, and of the two natural dangers, frost is the worse. A fairly healthy breath of frozen air kills a 'mum "deader than a doornail." Smudge pots have been used, but with little success.

Chrysanthemum culture isn't the pretty picture the uninitiated believe it to be, the Warnocks avow. In a strong wind, the cloth-covered houses have a tendency to take off across the country like sail boats in a regatta. 'Mum growing is a year-round proposition and requires year-round attention.

After the crop is cut and shipped, the residue plants are chopped off with a hoe. The roots lie dormant in the ground until the following spring, when they begin to root. Then it is 'mum planting time again.

Thousands of week-end visitors are not unusual at blossom-time on the Warnock 'mum farm. The desert flower-pot's blooming brilliancy is a sight for eyes weary of parched earth.

"I always tell the visitors about the wonders of irrigation," said Warnock. "Anybody desiring to see the results of reclamation should come down to El Paso and 12 miles on out to Ysleta. We're mighty happy to have company, and it pleases us greatly to know that many persons come back year after year to view the beauty of our work."

Warnock's irrigation supply flows from Elephant Butte Reservoir in New Mexico. The 155,000-acre Rio Grande project was constructed by the Bureau of Reclamation in the rich alluvial bottom land along the Rio Grande, where Spanish and Indian settlement and irrigation date back hundreds of years. The untreated water feeds the Warnock's flowers and helps them produce more abundantly than would be possible with water from an average municipal system. Moreover, it is much less costly.

Packed with the greatest of care, "Fragile" is the watchword.

Warnock estimates his original cost for readying his 16 acres to produce chrysanthemums totaled $4,000 an acre. However, after the initial investment, land preparation costs were no longer a problem. Warnock believes his is the most extensive commercial production of chrysanthemums in the Southwest, and the only one in the world on a Reclamation project. The firm's slogan, "Best in the Southwest," is well known among national florists. The Warnocks welcome inquiries about their farm. They're not at all mum about their 'mums.

Cabins of cloth prolong the blooming season and assure a steadier market.

AGRICULTURAL GOALS FOR 1947

1947 CROP AND LIVESTOCK PRO

COMMODITIES BY PLANTED ACR

State	Corn	Wheat	Hay	Oats	Cotton	Barley	Sorghums for grain	Seeds—Legumes and grass	Flax
Arizona	41,000	30,000	290,000	28,000	160,000	160,000	57,000	44,000	2
California	70,000	800,000	1,900,000	550,000	390,000	1,800,000	130,000	43,000	16
Colorado	850,000	1,850,000	1,100,000	250,000		800,000	300,000	70,000	
Idaho		1,300,000	985,000	191,000		285,000		70,000	
Montana	250,000	3,900,000	1,360,000	400,000		900,000		130,000	21
Nebraska	7,960,000	4,200,000	1,200,000	2,600,000		700,000	125,000	258,000	
Nevada		20,000	180,000	12,000		24,000			
New Mexico	150,000	400,000	190,000	40,000	130,000	40,000	250,000	32,000	
North Dakota	1,400,000	9,500,000	850,000	2,240,000		2,700,000	1,000	75,000	2,05
Oregon	42,000	1,000,000	850,000	400,000		250,000		53,000	
South Dakota	3,900,000	3,450,000	700,000	3,000,000		1,800,000	100,000	105,000	50
Texas	4,200,000	6,000,000	1,500,000	1,875,000	8,460,000	312,000	4,450,000	92,000	12
Utah	30,000	300,000	525,000	48,000		159,000		42,100	
Washington	32,000	2,750,000	915,000	270,000		130,000		6,100	
Wyoming	100,000	275,000	585,000	145,000		140,000		103,000	
Total, all Western States	19,025,000	35,775,000	13,130,000	12,049,000	9,140,000	10,200,000	5,413,000	1,123,200	3,07
Production total for the United States	91,550,000	70,700,000	61,110,000	44,669,000	23,100,000	13,084,000	7,500,000	6,515,000	5,00
Percent of National totals raised in Western States	20.8	50.6	21.5	27.0	39.6	78.2	72.2	17.2	

Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **William E. Warne, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management*, G. S. Ellsworth; *Chief Counsel*, Clifford E. Fix; *Chief Engineer and Director, Branch of Design and Construction*, Denver, Colo., Walker R. Young; *Chief Information Officer*, Barrow Lyons; *Chief Personnel Officer*, Glenn D. Thompson; *Acting Chief Progress Control Officer*, Arnold O. Babb; *Director, Branch of Operation and Maintenance*, Goodrich W. Lineweaver; *Director, Branch of Power Utilization*, Harvey F. McPhail; *Director, Branch of Project Planning*, John W. Dixon, *Director of Finance*, William F. Kubach; *Director of Supply*, S. W. Crosthwait

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, H. T. Nelson; *Assistant to Regional Director*, J. S. Moore; *Acting Regional Engineer, Branch of Design and Construction*, Wilfred L. Karrer; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, W. H. Tuller; *Regional Power Manager, Branch of Power Utilization*, Don S. Campbell; *Regional Planning Engineer, Branch of Project Planning*, E. N. Torbert; *Regional Finance Officer, Finance Division*, A. W. Empie; *Regional Information Officer, Information Division*, H. C. Blonk; *Regional Land Officer, Land Acquisition Division*, W. B. Wallace; *Regional Counsel, Legal Division*, H. R. Stinson; *Regional Personnel Officer, Personnel Division*, V. L. Rushfeldt; *Regional Progress Control Officer, Progress Control Division*, R. E. McGowan; *Regional Supply Officer, Supply Division*, James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Anderson Ranch Dam	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Black Canyon Dam	F. E. Hulet	Power superintendent	Emmett, Idaho.
Caldwell	R. W. Adams	Engineer	Caldwell, Idaho.
Cascade	Earl Harmon	Construction engineer	Cascade, Idaho.
Notus	T. E. Nelson	Irrigation manager	Notus, Idaho.
Nyssa	J. E. Spofford	do	Nyssa, Oreg.
Vale	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes	C. H. Spencer	Construction engineer	Bend, Oreg.
Hungry Horse	Paul A. Jones	Project engineer	Post Office Box 710, Kalispell, Mont.
Minidoka	S. R. Marean	Superintendent	Burley, Idaho.
Palisades	I. Donald Jerman	Project engineer	Post Office Box 1259, Idaho Falls, Idaho.
Umatilla	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.
Yakima	D. E. Ball	Superintendent	Yakima, Wash.
Yakima-Roza	Harold W. Pease	Assistant construction engineer	7½ 2d St., Yakima, Wash.
Rathdrum Prairie	Eugene Lavonture	Watermaster	Post Office Box 831, Post Falls Unit, Coeur d'Alene, Idaho.
Project Planning Offices			
Boise (Central Snake River district)	Vern Otter	Engineer	214 Broadway, Boise, Idaho.
Kalispell	C. S. Hazen	do	Post Office Box 97, Kalispell, Mont.
Medford	F. C. Hart	do	Post Office Box 1389, Medford, Oreg.
Salem	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla	M. Boyd Austin	do	Post Office Box 718, Walla Walla, Wash.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director*, R. S. Calland; *Assistant Regional Director*, Phil Dickinson; *Assistant to the Regional Director*, U. J. Gendron; *Regional Engineer, Branch of Design and Construction*, A. R. McGinness; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, J. G. Lindley; *Regional Power Manager, Branch of Power Utilization*, B. W. Creim; *Regional Planning Engineer, Branch of Project Planning*, S. A. Kerr; *Regional Finance Officer, Finance Division*, J. F. Kastl; *Acting Chief, Land and Right of Way Office*, W. E. Seyfarth; *Regional Information Officer, Information Division*, Max Stern; *Regional Counsel, Legal Division*, L. O. Graham; *Regional Personnel Officer, Personnel Division*, H. F. Osborne; *Regional Supply Officer, Supply Division*, H. F. Halliday

	Official in charge		Address
	Name	Title	
District and Project Offices			
Delta district	C. H. Kadle, Jr.	District manager	Post Office Box 1407, Sacramento 10, Calif.
Klamath district	Raymond R. Best	do	Post Office Box 312, Klamath Falls, Oreg.
Lower San Joaquin district	J. W. Rodner	do	Post Office Box 1270, Merced, Calif.
Sacramento Valley district	J. K. Carr	do	Post Office Box 302, Chico, Calif.
Colusa	C. L. Hudspeth	Engineer	Post Office Box 30, 114 Second St., Colusa, Calif.
Shasta Dam	I. C. Harris	Construction engineer	Redding, Calif.
Orland	E. R. Asdell	Superintendent	Orland, Calif.
Tulare Basin district	Robert B. Cozzens	District manager	Post Office Box 1129, Fresno, Calif.
Bakersfield	Henry Karrer	Field office superintendent	2510 M Street, Bakersfield, Calif.
Friant	R. K. Durant	Construction engineer	Friant, Calif.
Modesto	Jeffery Nielsen	Acting field office superintendent	Post Office Box 1372, 1115 Eye St., Modesto, Calif.
Tracy	G. C. Imrie	Resident engineer	Tracy, Calif.
Visalia	W. A. Alexander	Acting field office superintendent	Post Office Box 1269, E. Acequia and S. Bridge Sts., Visalia, Calif.
Project Planning Offices			
Santa Barbara	J. H. Fertig	Engineer	201 La Arcada Bldg., 1114 State St., Santa Barbara, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer, Branch of Design and Construction*, C. A. Bissell; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, A. B. West; *Regional Power Manager, Branch of Power Utilization*, R. V. Sprague; *Regional Planning Engineer, Branch of Project Planning*, E. G. Nielsen; *Regional Finance Officer, Finance Division*, M. E. Rains; *Regional Information Officer, Information Division*, W. J. Williams; *Chief, Land Acquisition Division*, O. J. Littler; *Regional Counsel, Legal Division*, R. J. Coffey; *Chief, Office Services Section, Supply Division*, A. G. Risley; *Regional Personnel Officer, Personnel Division*, M. H. Mitchell; *Regional Progress Control Officer, Progress Control Office*, D. A. Dedel; *Chief, Office of River Control*, C. P. Vetter

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).	G. W. Manly	Engineer	Do.
Coachella	C. S. Hale	Construction engineer	Coachella, Calif.
Gila (Construction)	T. A. Clark	do	Yuma, Ariz.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	Kingman, Ariz.
Parker Dam Power	S. A. McWilliams	do	Parker Dam, Calif.
Blythe	W. W. Gage	Engineer	Blythe, Calif.
Phoenix	W. E. Sims	do	Phoenix, Ariz.
Phoenix Substation	O. K. Mangum	do	Do.
San Diego	R. E. Burnett	do	Escondido, Calif.
Project Planning Offices			
Barstow	F. R. Smith	do	Fire Station, Barstow, Calif.
Escondido	R. E. Burnett	do	Post Office Box 357, 414 West 3d St., Escondido, Calif.
Holbrook	R. N. Parnell	do	County Fair Bldg., Post Office Box 608, Holbrook, Ariz.
Overton	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix	V. E. Larson	Assistant regional planning engineer	313 North Third Ave., Security Bldg., Phoenix, Ariz.
St. George	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant to Regional Director*, C. D. Woods; *Regional Engineer, Branch of Design and Construction*, C. H. Carter; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, D. S. Stuver; *Chief, Resources and Development, Branch of Power Utilization*, L. E. Mathews; *Regional Planning Engineer, Branch of Project Planning*, Reid Jerman; *Regional Finance Officer, Finance Division*, F. J. Farrell; *Regional Information Officer, Information Division*, Mack C. Corbett; *Regional Land Officer, Land Acquisition Division*, N. T. Olson; *Regional Counsel, Legal Division*, J. S. McMaster; *Regional Personnel Officer, Personnel Division*, H. G. Mignon; *Procurement Officer, Supply Division*, E. G. Bywater

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Newton	E. J. Wick	Engineer	46 East Center Street, Post Office Box 294, Logan, Utah.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. B. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Uncompahgre	O. F. Bartholomew	Economist	601 North Park Ave., Post Office Box 157, Montrose, Colo.
Area Planning Offices			
Carson City	W. H. Slattery	Engineer	Post Office Bldg., Post Office Box 179, Carson City, Nev.
Durango	J. J. Hedderman	Area engineer	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 87, Grand Junction, Colo.
Kemmerer	P. B. Delong	do	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	do	46 East Center, Post Office 294, Logan, Utah.
Spanish Fork	P. R. Neeley	do	Post Office Box 71, City Hall, Spanish Fork, Utah.
Vernal	H. E. Nielson	Engineer	Central School Bldg., Post Office Box 313, Vernal, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Texas

Regional Director, W. R. Nelson; *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Assistant Regional Engineer, Branch of Design and Construction*, O. I. Craft; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, R. S. Bristol; *Regional Power Manager, Branch of Power Utilization*, A. H. Sullivan; *Regional Planning Engineer, Branch of Project Planning*, E. T. Giles; *Assistant Regional Finance Officer, Finance Division*, C. L. Harris; *Regional Information Officer, Information Division*, G. L. Wilkinson; *Regional Counsel, Legal Division*, S. L. Baird; *Regional Personnel Officer, Personnel Division*, H. F. Kirby; *Regional Progress Control Officer, Progress Control Office*, D. R. Burnett; *Regional Safety Engineer, Safety Division*, A. T. Cromwell; *Regional Supply Officer, Supply Division*, I. G. Campbell

	Official in charge		Address
	Name	Title	
Project Offices			
Altus	H. E. Robbins	Construction engineer	Altus, Okla.
Balmorhea	R. J. Walters, Jr.	do	Balmorhea, Tex.
Carlsbad	T. B. Thomas	Acting project superintendent	Carlsbad, N. Mex.
Elephant Butte Power	J. H. Sherwin	Superintendent of power	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Rio Grande	L. R. Flock	Project superintendent	U. S. Courthouse, El Paso, Tex.
San Luis Valley	D. M. Forester	Project engineer	117 Jefferson St., Monte Vista, Colo.
Tucumcari	M. M. Starr	Construction engineer	Tucumcari, N. Mex.
Valley Gravity	C. P. Seger	Area planning engineer	McAllen, Tex.
Ysleta	F. D. Postle	Division superintendent	Ysleta, Tex.
Project Planning Offices			
Albuquerque	J. L. Muts	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	L. W. Smith	Acting area planning engineer	Littlefield Bldg., Austin, Tex.
Oklahoma City	M. O. Barclay	do	Post Office Box 495, 316 Key Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Stapleton Building, Post Office Box 2130, Billings, Mont.

Regional Director, H. D. Comstock; *Assistant Regional Director*, Kenneth Vernon; *Acting Assistant to the Regional Director*, H. W. Johnson; *Regional Engineer, Branch of Design and Construction*, C. G. Anderson; *Regional O. & M. Superintendent, Branch of Operation and Maintenance*, H. H. Johnson; *Regional Power Manager, Branch of Power Utilization*, J. R. Walker; *Regional Planning Engineer, Branch of Project Planning*, C. T. Hinze; *Regional Finance Officer, Finance Division*, Duncan Mills; *Regional Information Officer, Information Division*, H. I. Sylten; *Regional Land Officer, Land Acquisition Division*, W. N. McCormick; *Regional Counsel, Legal Division*, W. J. Burke; *Project Development Supervisor, Missouri Basin Project Development Staff*, William E. Rawlings; *Chief, Reports Staff, Missouri Basin Reports*, Mills E. Bunger; *Regional Personnel Officer, Personnel Division*, Alfred W. Gaede; *Assistant Progress Control Officer, Progress Control Division*, Don H. Huff; *Office Manager, Supply Division*, Gerald Fitzgerald

	Official in charge		Address
	Name	Title	
Project Offices			
Angostura unit	H. V. Hubbell	Project engineer	Evans Hotel, Annex Bldg., Post Office Box 12, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Federal Bldg., Newell, S. Dak.
Bitterroot-Missoula Valley	C. R. Whipple	Construction engineer	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Boysen & Owl Creek units	R. S. Lieurance	Project engineer	Post Office Box 1111, Thermopolis, Wyo.
Buffalo Rapids	J. W. Grimes	Construction engineer	Masonic Temple Bldg., Terry, Mont.
Fort Peck	Allen Mattison	Resident engineer	Post Office Box 1245, Fort Peck, Mont.
Intake	J. W. Grimes	Construction engineer	Masonic Temple Bldg., Terry, Mont.
Milk River	H. W. Genger	Superintendent	Malta, Mont.
Rapid Valley	H. V. Hubbell	Project engineer	Evans Hotel Annex Bldg., Post Office Box 812, Hot Springs, S. Dak.
Riverton	D. L. Carmody	do	Post Office Bldg., Riverton, Wyo.
Shoshone (O. & M.)	L. J. Windle	Superintendent	Federal Bldg., Powell, Wyo.
Shoshone-Heart Mountain (Construction)	W. F. Kemp	Construction engineer	Post Office Bldg., Cody, Wyo.
Sun River	C. L. Bailey	Superintendent	Federal Bldg., Fairfield, Mont.
Project Planning Offices			
Billings	Carl L. Myers	Engineer	Post Office Box 1264, Billings, Mont.
Bismarck	Bruce Johnson	do	Post Office Box 328, First National Bank Bldg., Bismarck, N. Dak.
Hardin	Frank R. Dickey	do	Gay Bldg., Post Office Box 516, Hardin, Mont.
Helena	F. V. Munro	do	Post Office Box 1164, 412 Federal Bldg., Helena, Mont.
Miles City	R. B. Kuebler	do	Wilbaux Bldg., Post Office Box 720, Miles City, Mont.
Minot	George J. Cheney	do	Jacobson Bldg., Post Office Box 1869, Minot, N. Dak.
Pierre	W. W. Baker	do	Hyde Bldg., Post Office Box 122, Pierre, S. Dak.
Wolf Point	H. W. Mutch	Acting project engineer	Court House, Post Office Box 971, Wolf Point, Mont.
Great Falls	T. R. Smith	Engineer	1015 1st Ave. N., Post Office Box 1729, Great Falls, Mont.

REGION VII: Headquarters, 501 Continental Oil Building, Denver, Colo.

Regional Director, E. B. Debler; *Assistant Regional Director*, Avery A. Batson; *Regional Engineer, Branch of Design and Construction*, Walter E. Blomgren; *O. & M. Supervisor, Branch of Operation and Maintenance*, John N. Spencer; *Power Manager, Branch of Power Utilization*, Harold R. Lee; *Planning Engineer, Branch of Project Planning*, John A. Keimig, *Finance Officer, Finance Division*, Carl M. Voyen; *Acting Information Officer, Information Division*, Maurice V. Mechau; *Land Officer, Land Acquisition Division*, Mark W. Radcliffe; *Acting Regional Counsel, Legal Division*, Clarence Eynon; *Personnel Officer, Personnel Division*, Albert R. Novak; *Supply Officer, Supply Division*, William F. Sha

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Guernsey	W. S. Francescato	Clerk	Guernsey, Wyo.
Kortes	C. S. Rippon	Construction engineer	Do.
Seminole Dam	E. J. Walters	General foreman	Seminoe Dam, Wyo.
Cedar Bluffs	C. E. Klingensmith	Project engineer	Box 616, Hays, Kans.
Colorado-Big Thompson	C. H. Howell	do	Estes Park, Colo.
Fort Morgan	G. W. Hall	Foreman	Fort Morgan, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Green Mountain Dam (O. & M.)	W. E. Bumpas	General electric foreman	Kremmling, Colo.
Horsetooth Reservoir	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	Nat C. Brown	Engineer	Loveland, Colo.
Frenchman-Cambridge	H. E. Robinson	Project engineer	Box 737, McCook, Nebr.
Enders Dam	U. V. Engstrom	Construction engineer	Imperial, Nebr.
Kirwin	C. E. Klingensmith	Project engineer	Box 163, Phillipsburg, Kans.
Ainsworth (Niobrara Basin)	C. E. Burdick	Engineer	Ainsworth, Nebr.
Casper (North Platte Basin)	I. J. Matthews	District manager	Casper, Wyo.
Cheyenne (South Pass diversion and Yampa-North Platte diversion project).	E. H. George	Engineer	Box 658, Cheyenne, Wyo.
Denver (Blue River-South Platte)	J. H. Knights	do	331 United States National Bank Bldg., Denver, Colo.
Grand Island (Platte River Investigations).	P. L. Harley	do	Grand Island, Nebr.
McCook (Republican River division)	H. E. Robinson	Project engineer	Box 737, McCook, Nebr.
Pueblo (Gunnison-Arkansas and Upper Arkansas River Basin).	B. F. Powell	Engineer	Box 515, Pueblo, Colo.
Topeka (Kansas River investigations)	W. C. Brady	do	505 New England Bldg., Topeka, Kans.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Beer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho.
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	Superintendent.	Louie Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hilbel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr.	President	Joseph R. Tuddenham.	Newton, Utah
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Throp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	Goerge A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Al Hiat	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellenburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1947

WHEN the Secretary of Agriculture announced the 1947 agricultural acreage goals, what did it mean to the reclamationists of the West?

During the war years crop production on the operating Federal reclamation projects followed the requested annual shifts in crops planted very closely. A review of the 1945 crops grown on reclamation projects shows that reclamation farmers produced much-needed food, forage, seed and livestock to meet critical shortages. An analysis of the 1947 goals indicates that the important crops grown on reclamation projects are still needed on a sustained or a stepped-up production basis.

The Secretary of Agriculture has set high goals for the farmers of the United States. According to his announcement, the final farm production goals for 1947 call for a total planted acreage in the United States of 356,893,000 acres to meet the food and fiber requirements of the Nation. This is substantially higher than the 345,111,000 acres planted in 1946, and the prewar average of 341,605,000 planted acres.

These final goals take into consideration the record output of 1946 crops, the need for increased plantings of flaxseed, and recommendations made by State councils of the United States Department of Agriculture.

Final goals have also been set for livestock and livestock products.

In connection with the 1947 schedule calling for top production, Secretary Anderson has said:

The production job farmers face next year is fourfold. We must produce to meet the needs of strong domestic demand and to supply some of the foods and other farm products still badly needed in war-devastated areas. Added to these is the job of starting to build up reserves of certain commodities, and the compelling need to work again toward a sounder program of proper land use and soil conservation.

The cultivated acreage on reclamation projects will total only 1.26 percent of the national acreage and according to preliminary reports of 1946 acreages, about 3.62 percent of the acreage in the Western States.

The table at the bottom of this page shows what the Department of Agriculture is calling for in crop production in the Western States, so that reclamation farmers can scrutinize these agricultural goals. They can then form some idea as to how the crops which they are growing fit into the total agricultural picture for the West and the country as a whole.

Compared with 1946 figures, the 1947 goals fluctuate. Much more cotton, flax, dry beans, soybeans, barley, and grain sorghums are called for. But farmers are asked to cut down on corn, oats, dry peas, peanuts, potatoes, and truck crops. Substantial shifts from certain war-emphasized crops are requested in some areas, while in others suggested changes in crop goals will necessitate a fuller use of the land.

The sugar beet acreage called for, or 1,069,000 acres, is 15 percent greater than that planted in 1946. A price of $14.50 per ton of beets has been guaranteed, which is $1 per ton more than the 1946 price.

FEDERAL RECLAMATION PROJECTS

Commodity	1945 acreage in cultivation	Percent of total United States acreage in 1945
Wheat	271,723	0.4
Rye	15,481	.8
Dry beans	157,255	10.0
Corn	55,564	.05
Oats	144,576	.3
Barley	326,715	3.2
Cotton	166,709	.9
Sugar beets	180,803	25.2
Potatoes (all)	265,841	9.4
Sweetpotatoes	849	.1
Truck crops (all)	181,816	4.7
Alfalfa hay	1,126,646	7.6
Total acreage	4,195,732	1.2

Continuing large requirements for linseed oil have brought about a boost in the support price of flaxseed to $6 a bushel, U. S. No. 1, Minneapolis basis.

When you compare the crops actually grown on Federal reclamation projects with the total grown by the Nation's farmers in 1945 (a record-breaking crop year), you can see that the specific crops do not constitute any sizable portion of the total planted acreages throughout the Nation.

(*Continued on page 63*)

...N GOALS BY WESTERN STATES

...toes	Rye	Dry beans	Sugar beets	Dry peas	LIVESTOCK: Chickens	Turkeys	Sheep and lambs	Cows (dairy)	Cows (beef)	Hogs	Bees (colonies)
...4,600	.....	18,000	.....	.....	760,000	100,000	524,000	50,000	464,000	4,000	69,000
...1,700	10,000	377,000	180,000	.....	21,200,000	3,700,000	1,855,000	830,000	546,000	61,000	470,000
...5,200	60,000	350,000	200,000	30,000	5,600,000	900,000	1,500,000	211,000	550,000	48,000	79,000
...5,300	6,000	150,000	95,000	.....	3,800,000	300,000	1,050,000	220,000	146,000	33,000	170,000
...9,100	30,000	30,000	88,000	28,000	4,200,000	300,000	2,160,000	140,000	680,000	32,000	56,000
...3,400	300,000	70,000	80,000	.....	28,000,000	1,450,000	200,000	550,000	902,000	531,000	64,000
...3,000	.....	.....	500	.....	390,000	50,000	550,000	18,000	193,000	4,000	14,000
...4,900	5,000	270,000	500	.....	1,320,000	60,000	1,500,000	61,000	652,000	9,000	19,000
...5,900	400,000	1,000	18,000	10,000	10,000,000	1,200,000	630,000	465,000	319,000	144,000	25,000
...5,400	38,000	1,000	22,000	22,000	4,500,000	2,100,000	729,000	231,000	326,000	25,000	72,000
...0,200	400,000	.....	10,000	.....	14,500,000	500,000	1,140,000	401,000	573,000	375,000	20,000
...5,500	20,000	4,000	1,500	.....	35,260,000	4,400,000	9,575,000	1,320,000	2,700,000	198,000	292,000
...5,100	8,000	7,000	50,000	.....	2,670,000	1,850,000	1,930,000	110,000	135,000	12,000	55,000
...3,600	16,000	4,000	17,000	235,000	8,240,000	1,500,000	325,000	335,000	137,000	26,000	70,000
...5,000	10,000	80,000	55,000	.....	1,600,000	200,000	2,450,000	65,000	442,000	12,000	44,000
...3,900	1,303,000	1,362,000	817,500	325,000	142,040,000	18,610,000	26,118,000	5,007,000	8,765,000	1,514,000	1,519,000
...9,800	2,374,000	2,150,000	1,069,000	478,000	677,110,000	40,666,000	35,299,000	24,418,000	14,861,000	9,162,000	6,151,000
30.7	54.9	63.3	76.5	68.0	21.0	45.8	74.0	20.5	59.0	16.5	24.7

Investment Insurance

How irrigation played the major role in providing a profitable and record-breaking harvest in the Southwest

by John P. Woodward,

Chief, Project Activities, Region V, Amarillo, Tex.

Sweet potatoes mean sweet revenue.

Irrigation paid off to the tune of $43,000,000 on four region V Bureau of Reclamation projects in 1946. This was the gross income of crops, livestock, and livestock products produced on 184,608 irrigated acres on the Bureau's Rio Grande project in New Mexico and Texas, the Carlsbad project in southeastern New Mexico, the Tucumcari project in east central New Mexico, and the Altus project in Oklahoma.

Dollars Roll In

The multimillions rolled into irrigation farmers' coffers in a year when many parts of the Southwest were experiencing some of the worst drought conditions and water shortages within the past decade. Rainfall was below normal for most of the summer months and continued hot weather lowered water supplies to a critical point. But with irrigation water available the hot, dry weather was ideal for early harvesting of cotton. As irrigation farmers were able to unload their cotton when market prices were high, income from this crop soared to record figures.

King cotton ruled the Rio Grande project in 1946 when values of the fleecy staple in the Messila and El Paso Valleys below Elephant Butte Dam, completed in 1916 by the Bureau, reached an all-time record of $31,353,471, an increase of $14,500,00 over the 1945 income.

Total value of all crops grown on this project was $38,771,051, also an all-time mark. The income from the 156,567 irrigated acres in cultivation averaged $247.47 per acre. Sales of livestock and livestock products increased gross returns to $40,656,528. Crop values for the banner year were about double the gross construction cost of the entire project to date.

At Carlsbad, N. Mex., another Bureau of Reclamation project reported a near-record year with 1946 crops valued at $1,984,380, an average of $99.95 per irrigated acre. These figures are all the more impressive when it is realized they were achieved in a year of drought which resulted in water shortages in the water shed and on the project, described as "the worst in history." Values in the 20,000 acres irrigated in the Carlsbad district were surpassed only by the $1,988,546 report of 1919 and the record $2,239,908 income of 1924.

At Carlsbad, cotton also was the major product, accounting for $1,177,815 of the total revenue. The 8,535 acres planted to cotton produced 6,263 bales valued at $939,540 and 2,647 tons of seed worth $238,275.

Bureau of Reclamation projects at Tucumcari and Altus entered the production stage for the first time in 1946. At Tucumcari, 2,526 irrigated acres in the Arch Hurley conservancy district produced crops valued at $216,108.51, an average of $85.53 per acre. By the end of 1947 the Bureau is scheduled to have completed at Tucumcari construction of facilities for the irrigation of 25,000 acres with about 6,000 acres actually receiving water for 1947 crops. The project contains 45,000 irrigable acres.

While irrigated acreage was small at Altus in 1946, the comparison between returns from irrigated and nonirrigated acres was significant. The value of crops raised on 451 irrigated acres averaged $130.72 compared to a $22.09 average on surrounding nonirrigated farms. Water for the project is stored behind Altus Dam, completed by the Bureau early in 1946. Ultimately about 53,000 acres will receive water. Facilities for the irrigation of approximately 20,000 acres are scheduled to be constructed in 1947, with from 8,000 to 10,000 acres actually receiving water during the growing season.

After scattered hail storms in May, weather conditions in the Rio Grande project area were ideal for growing, and permitted rapid and uninterrupted cotton picking during harvest. This enabled most of the gins to close in mid-January while ordinarily the crop is not completely ginned before the latter part of February.

Market prices were higher for all general crops, particularly cotton and alfalfa which were grown on 90 percent of the cultivated Rio Grande area. The average price for Acala cotton was $172.50, compared to

$117 a bale in 1945. Alfalfa at $27.42 a ton was considerably higher than the previous year's average of $18.95. Long staple cotton brought $250 a bale in 1946 and $215 a bale in 1945. Seed averaged $84 a ton compared to $60 for Acala and $63 for long staple seed in 1945.

The Rio Grande project produced 152,282 bales of cotton in 1946, an increase of 34,735 bales over the previous year. Production of long staple, once a substantial part of the total, has declined. Long staple production was only 935 bales. The remainder was Acala, which averaged 1.45 bales to the acre on 104,048 acres. Value of Acala cotton seed and lint combined averaged $289.74 per acre.

Alfalfa was second to cotton in value in the Rio Grande project area. This feed crop averaged 4.4 tons an acre from 35,739 acres. Total income from alfalfa was $4,309,668, an average of $120.59 per acre. Other hay planted on 434 acres was valued at $25,253.

The 7,635 acres devoted to vegetable and truck crops grossed $1,500,715 for a per acre average of $196.55.

The cereal group was produced on 3,501 acres from which a $201,383 crop was harvested. Seed crops on 2,577 acres were valued at $410,481. Fruits and nuts proved the least profitable crops when 4,500 acres grossed $295,615 for an average of $65.70 per acre.

A specialty crop of flowers topped the Rio Grande project area in per acre revenue. Flowers on 22 acres had a value of $58,850, or $2,675 per acre. Nursery stock on 59 acres was valued at $29,068, a per acre average of $492.67.

Through good years and bad, irrigated land will produce dependable crops, but it is in years of extreme drought that the true worth of irrigation becomes outstandingly apparent.

King cotton caused the smile.

_____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

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Agricultural Goals for 1947

(*Continued from page 61*)

The table (p. 61) shows the area in cultivation in 1945, including lands which were receiving water under Warren Act contracts. Although the percentage of the 1945 national cropped acreage is small, it is evident that the products grown were those for which there was great demand during the war years, and in most instances are those for which the Department of Agriculture is calling for higher production in 1947.

In reviewing the 1947 outlook for crop production on Federal Reclamation projects, Commissioner Straus has expressed the hope that the farming programs on these irrigated areas will be carefully planned and that soil building practices will be used where intensive cultivation of wartime crops may have depleted the soil fertility.

Number One Jobs in th

Predevelopment Paves the Way

by H. P. Singleton,

Superintendent, Irrigation Branch Experiment Station, Prosser, Wash.

Tests and surveys remove some of the risk for future farmers—well

Successful crops make a successful farmer. All other factors being even, anyone starting operations on new land, in a new territory, usually either has to guess right the first time, or spend several years experimenting, until he learns by experience what crops are most profitable.

Farmers entering reclaimed lands in the Columbia River Basin will know in advance what kinds and varieties of crops are most likely to succeed. Through the cooperation of the Bureau of Reclamation, the Department of Agriculture, and Washington State agricultural agencies, this information will be gathered on two farms in the area. One of 48 acres in the southerly part of the irrigation project is known as the Pasco farm. The other, of 81 acres, near the center of the project, is known as the Moses Lake farm. On these two tracts, exploratory work will be carried out in all kinds of crops that might possibly be grown. This will be in addition to the more customary type of studies on irrigation and fertility requirements, control of insects and diseases, control of salinity, use of crop rotation and crop utilization.

Started before actual irrigation development in the basin, this is a new type of program, in that it will attempt to solve in advance many of the problems that would otherwise occur as new farm families settle on the lands. The advantage in putting irrigated farms on an immediate paying basis is obvious. It is significant, too, because irrigated areas in the State of Washington, while only 20 percent of total cropped acreage, bring in a gross revenue to farmers greater than the remaining 80 percent. Since development of the Columbia Basin project will about triple the irrigated lands in the State, the economic gain in putting the new acreage to profitable use immediately is easily seen.

Drilling a water-supply well on the Bureau's No. 1 "guinea pig" farm at Moses Lake.

To bring water to the predevelopment farms, wells will be used until water from the irrigation works becomes available. The facilities on the farms will be constructed by the Bureau of Reclamation with the assistance of the Extension Service of the Department of Agriculture and the various departments of the Washington agricultural experiment stations in planning. The Bureau of Reclamation will then operate the units and a part of each unit will be set aside for the experimental programs of the other agencies. In this way, the units will serve as demonstration farms for the settlers while permitting investigations in the field.

It is planned to continue the experimental farms in operation through the first few years after settlers arrive, to help them during their adjustment period. As new areas are scheduled for irrigation, other predevelopment farms will be established.

The concern of agencies responsible for making recommendations to farmers on irrigated lands is also manifested by other actions taken in the basin area. The Washington agricultural experiment stations have available two of the main types of soils in the Columbia Basin at the Irrigation Branch Experiment Station at Prosser, Wash. These are the "Sagemoor" and the "Ritzville" types. Research on the Sagemoor type began when the station was established in 1919. Recently the board of regents of the State College of Washington authorized the purchase of a half section of soil of the Ritzville type.

olumbia Basin Project

ackground.

Development on this land which lies in the Roza project of the Bureau of Reclamation was started in 1946. Cooperative work is being conducted by the Agriculture Department's Bureau of Plant Industry, Soils and Agricultural Engineering, through its Division of Soils, Fertilizers and Irrigation.

At Hermiston, Oreg., is the Umatilla field station of the Bureau of Plant Industry. The soil on this station is of the Ephrata series, one of the lightest soil types among those irrigated in the Columbia Basin. This facility also will be used in the studies.

Additional research assistance has been provided on the staff of both the Prosser and Umatilla stations. In addition to these Department of Agriculture technicians, the Washington State agricultural staff has given special attention to the problem. The entire work is being coordinated by the superintendent of the irrigation branch experiment station.

It is hoped thereby that the program will give opportunity to carry the results of the findings to all the new areas to be irrigated before the water is delivered to the land.

C B Job Year Ahead of Schedule

Excavation of the southern section of the gigantic main canal of the Columbia Basin project in eastern Washington is nearing completion almost a year ahead of schedule.

Although the contractor for the 6.6 miles of canal, Morrison-Knudsen Co. of Boise, Idaho, was allowed 750 calendar days, a goal of 300 days has been set to finish this job.

The Monighan Digs In

With giant strides, the walking dragline continues its history-making tour at the Columbia Basin project

The biggest piece of earth-moving equipment ever seen in the Pacific Northwest, a million-pound walking dragline, started work October 11, 1946, on the biggest construction job ever undertaken in the Pacific Northwest, the Columbia Basin project irrigation system.

Built in 1939 by the Bucyrus-Monighan Co., the dragline (a 9–W) has a factory rating of about 9 cubic yards when using a 170-foot boom. However, its owners, J. A. Terteling & Sons, Inc., Boise, Idaho, have attached Paul Bunyan buckets with which it will handle 15 yards of rock or 20 yards of common dirt at a scoop. In a 24-hour shift, the Monighan will move 9,000 yards of rock or from 12,000 to 13,000 yards of earth. The eastern Washington rock is estimated to weigh 2.1 tons per yard.

Equipped with a 630-horsepower Diesel engine, the Monighan has moved many millions of cubic yards of material on Bureau of Reclamation jobs and other contracts. It arrived on the Columbia Basin project from the Tucumcari, N. Mex., project. Prior to that it was on river-channel work in the Mesabi iron fields in Minnesota. Earlier, it was used for changing a river channel in South Carolina.

On the Columbia Basin project, the Monighan will handle virtually all excavation for the northern portion of the river-size Main Canal, which leads from the South Dam at Coulee City, Wash. Its way will be prepared by a blasting crew which will use 2,000,000 pounds of dynamite to break the tough, flint-like lava that characterizes the famed coulee area of eastern Washington.

Although walking draglines are not new to the construction field, their higher initial costs and their unusual size generally have restricted their use to the larger jobs. The Monighan on the Columbia Basin project has a circular base 30 feet in diameter on which it rests while excavating. In moving, it uses its two feet, which operate on an eccentric cam, moving inside an oval track frame.

As the two feet are lowered simultaneously, and pressed against the ground, the Monighan is lifted from its base and slides forward. The feet then are lifted, moved forward, and again lowered for the next step. The 9–W's shoes are 36½ feet long and 6½ feet wide. It takes a 7½-foot step and travels about 1 mile in 7 hours.

On the main canal job, the Monighan is scheduled to handle about 300,000 cubic yards of common and nearly 2,000,000 cubic yards of rock. Approximately 100,000 yards of the common excavation will be under a subcontract with the Bair-Crick Co., holders of the South Dam contract for the Grand Coulee Equalizing Reservoir, which will store water for the million-acre project.

Boy, that's only part of it!

FUTURE HOMESTEADERS

Three who won farms in the Tule Lake Division of the Klamath Project in California-Oregon during the recent drawing at Klamath Falls

by John A. Leveritt, *Region III, Boulder City, Nev.*

Vernon Elwood McVey

He flew under the deadline

"I'm looking for some land." It was Thursday evening, September 12, 1946. Vernon Elwood McVey, ex-Army Air Force pilot, had been looking over the Yuma Mesa division of the Gila project. Unexpectedly he met and thus greeted his former agronomy professor, Ian A. Briggs (now a Bureau of Reclamation official) at the San Carlos hotel in Yuma, Ariz.

"Too bad," said Briggs. "You are just a little late—applications have to be in on the Tule Lake division lands of the Klamath project in Oregon by 2 p. m. this Sunday—September 15." He went on to explain the lost opportunity.

McVey wasn't going to let the opportunity slip by. He started figuring time and distance. The next morning he began a series of hurried automobile trips over the State of Arizona. First to the Phoenix Bureau of Land Management office for an application blank, where he learned the cost per acre to be repaid over a period of 40 years without interest. Only $88.35 an acre for some of the richest land in the country. He laughed at the calendar Friday the 13th!

Not superstitious, he phoned Klamath, Oreg., and was assured that, although there were thousands of applications, he would have just as good a chance as anyone else—IF he made the deadline.

From Phoenix, he drove to his dad's farm near Parker, Ariz. His father, Marshall F. McVey, caught his son's enthusiasm, but urged him to take a short rest. Saturday morning McVey completed the application, took it to town to be notarized.

Time was growing short. McVey enlisted the aid of his friend, Marion Beaver, a former Navy pilot, owner of an Army surplus airplane. These arrangements seemed to eat up the remaining time. Finally they took off by airplane to Klamath Falls, Oreg., and breathlessly submitted the all-important application blank with a few minutes to spare.

"After I had the application in, I realized that my chances were pretty slim. I had spent about $200 on the gamble." Not a bad investment, considering what he won.

Shortly after the war began, Vernon was drafted. He was accepted for flying training in November 1942 and was commissioned in October 1943 and assigned to the Army Air Field at Del Rio, Tex. There he met his pretty wife, Virginia, the daughter of a Texas rancher. They were married in Florida in January of 1944.

William E. Macy

He nearly gave up

"If I had been there I would probably have given up," says William Elsworth Macy, a young veteran of Lakeside, Calif. His name was drawn last.

At the beginning of the drawing there were 1,305 names of applicants who had been judged qualified. With 85 names gone that left Bill with 1,220–to–1 odds.

Bill has another claim to distinction among the winners—every member of his family is a veteran, including his mother.

His father, Elmer H. Macy, a retired police officer of San Diego, Calif., now farming near Lakeside, was in the Army during World War I. Bill's brother, Paul R. Macy, 22, is a first lieutenant in the Air Forces and is now stationed in Austria.

Bill was drafted into the Army in February 1943 and was assigned to a mobile communications squadron later attached to the Ninth Air Force in Europe.

His mother, Mrs. Jane Macy, was a member of the Women's Army Corps.

Bill is 23 and was born in Los Angeles May 12, 1923. He got his experience in irrigation farming which made him eligible to apply for a homestead on the family's farm in Moorpark, Calif.

Walter Max Hulse

He was from Missouri

"That is the best land I ever saw. Even beats that good Missouri River bottom-land all hollow," declared Walter Max Hulse, of La Habra, Calif., one of the 86 veterans whose names were drawn to make a homestead entry on this first Bureau project to open for veteran entry since the end of the war.

Walter, a man of the soil nearly all his life, gained his impression of the quality of the Tule Lake land when he inspected it several months ago. He had been to Grants Pass, Oreg., to look over some land for purchase. En route home, he stopped by the project and decided not to buy any land until he tried to get a farm through homestead entry.

"Even if money was no object, you could not buy better land. I would rather have it than developed land which I have seen priced at more than $500 an acre," he said.

"My plans are not definite for the first year's operation," he said. "I am going to follow the advice of the county agent. All I am sure of is that there will be plenty of work for the first few years. But these calluses did not get here by just sitting around thinking."

Walter was born near Springfield, Mo., February 10, 1911. When he was 11 years old his father died and the three boys ran the farm.

In 1935 he went to southern California where he gained his irrigation farming experience on farms and citrus groves. He was drafted into the Army in November of 1942, after 2 years in a defense plant which manufactured heavy duty lathes and aircraft parts. In the Army he served with the Air Transport Command and was discharged January 27, 1944.

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Approved Missouri River plan map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

2. *Maps of seven States showing water resources development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations in color of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. (Also available from regional directors, Bureau of Reclamation, region VI, Billings, Mont., and region VII, Denver, Colo.)

3. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

4. *The Colorado River.*—Comprehensive departmental report on development of water resources of Colorado River Basin for review prior to submission to the Congress. Limited number of copies available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

5. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, seven-page mimeographed study with graphs.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Table showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

4. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

5. *Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945,* published January 4, 1946. Fourth annual financial statement of the Commissioner of Reclamation transmitted to the Secretary of the Interior concerning operation, maintenance, and construction activities of the Boulder Canyon project during the year ended May 31, 1945. Ten cents a copy.

Miscellaneous Publications

Agricultural Research in South Dakota, fifty-eighth annual report of the South Dakota Agricultural Experiment Station, by I. B. Johnson, director, July 1, 1944, to June 30, 1945. Report contains data on the progress of the research projects conducted by the station's scientists, brief summary of the activities of the substations, and condensed financial statement of the research funds used. For information write to the South Dakota Agricultural Experiment Station, South Dakota State College of Agriculture and Mechanic Arts, Brookings, S. Dak., 47 pages with illustrations.

Veterans' Training Course Turns Out Journeymen Craftsmen, by I. L. Bateman, Los Angeles Department of Water and Power, in *Electrical World,* July 20, 1946, page 60—illustrated. Nine apprentice training schools train 331 veteran enrollees to be future linemen, cable splicers, servicemen and conduit men in utility training program.

Building the Atomic Bomb Plant, in *The Constructor,* July 1946, page 95—illustrated. The story of the construction of the atomic bomb plant at Oak Ridge, Ky.—a record-breaking job by general contractors.

Shooting Concrete into Walls Cuts Lumber Use and Labor Costs, in *Engineering News-Record,* July 11, 1946, page 100—illustrated. To overcome the current lumber shortage a west coast contractor builds walls with gunite shot against a single outside form, which method speeds construction and cuts costs.

Your Government's Records in the National Archives, by W. Brooks Phillips under the supervision of Philip M. Hamer, Records Control Officer, National Archives, 1946, 81 pages with index (National Archives Publication No. 46–18). A condensed description of the vast store of records in the National Archives and the pattern of their arrangement. Copies free of charge upon request of the Archivist, National Archives, Washington, D. C.

A Housing Project for Davis Dam, in *Construction Methods,* July 1946, page 91—illustrated. The Utah Construction Co. builds housing facilities for construction and office personnel as the first step in building for the Bureau of Reclamation the earth and rockfill Davis Dam across the Colorado River in Arizona.

What About International Standards for Building Dimensions?, in *Industrial Standardization,* July 1946, page 160—illustrated. An international housing shortage brings to the United Nations Standards Coordinating Committee suggestions for international standards as aids in bringing about speedier progress in building. Industrial Standardization is published monthly

by the American Standards Association, 70 East Forty-fifth Street, New York, N. Y.

Bibliography of Agriculture, publications of the United States Department of Agriculture, State agricultural experiment stations, State agricultural extension services, and books and pamphlets from other sources listed by the departmental library, 162 pages (mimeographed) with author and subject indexes—August 1946, volume 9, No. 2.

Agriculture in Oregon, prepared by the Oregon State Department of Agriculture. Brief answers to the questions of civilians and servicemen concerning Oregon agriculture and the State, 20 pages with illustrations, issued in 1946. Write to the Oregon State Department of Agriculture, Salem, Oreg.

Looking Forward in Oklahoma Agriculture, published by the Division of Agriculture, Oklahoma Agricultural and Mechanical College, June 1946. Experiment Station Bulletin No. B–299. 92 pages with illustrations. An inventory of Oklahoma's agricultural resources; an analysis of major aspects of the State's farm industry and rural life with suggestions for future development. For information write to the Division of Agriculture, Oklahoma Agricultural and Mechanical College, Stillwater, Okla.

Report on the Columbia River Power System (fiscal year 1945), prepared by the Bonneville Power Administration, Department of the Interior, June 30, 1945. 35 pages with illustrations. Report shows the results of operation of the Bonneville Power Administration from July 1, 1938, to June 30, 1945, and includes certified financial statements for the Columbia River power system. Write to the Bonneville Power Administration, Portland, Oreg.

"Sprinkler Irrigation," by Gustav H. Bliesner, assistant extension engineer, Agricultural Extension Service, Institute of Agricultural Sciences, State College of Washington, Pullman, Wash., Extension Bulletin No. 336, *Washington Irrigation Series*, March 1946. 20 pages. Illustrated. A graphic explanation of the advantages of the sprinkler irrigation method. For copies write E. V. Ellington, director, College of Washington Extension Service, Pullman, Wash.

Mineralogical and Physical Composition of the Sands of the Oregon Coast from Coos Bay to the Mouth of the Columbia River, prepared by Dr. W. H. Twenhofel, Head of the Department of Geology, University of Wisconsin for the Department of Geology and Mineral Industries, State of Oregon, 1946. Bulletin No. 30. 66 pages with illustrations. Bulletin gives the results of painstaking field and laboratory studies of the sands of the northern two-thirds of the Oregon coastal area. 35 cents a copy from the Department of Geology and Mineral Industries, State of Oregon, Portland, Oreg.

Soil—A Foundation of Health, by Arnold P. Yerkes, supervisor, Farm Practice Research, International Harvester Co., 1946. 12-page pamphlet. The relation of soil to *your* health and the health of the nation. Obtained on request from Consumer Relations Department, International Harvester Co., Chicago, Ill.

Statement of the Federal Power Commission to the Seventy-Ninth Congress. (Fiscal year ended June 30, 1944.) 31 pages. Report on new applications for preliminary permits and licenses, and renewal of licenses, for power and transmission-line projects, and proceeds derived from licenses issued. Copies of the statement obtainable from the Federal Power Commission, Washington, D. C.

"Use of Aerial Photos in Controlled Mapping," by Pliny Gale, chief engineer, Jack Amman Photogrammetric Engineers, in a bulletin of the Agricultural and Mechanical College of Texas reporting a *Postwar Planning Conference for Controlled Surveying and Mapping.* (Page 36.) Report of the *Conference*—sponsored by School of Engineering, Agricultural and Mechanical College of Texas; College of Engineering, University of Texas and General Land Office, State of Texas and held in Austin, Tex., November 14–15, 1944—published in Bulletin No. 86, School of Engineering, Texas Engineering Experiment Station, College Station, Tex. Write to the School of Engineering, Agricultural and Mechanical College of Texas, College Station, Tex.

Cash Receipts from Farming by States and Commodities, Calendar Years 1924–44, compiled by Gertrude A. Gronbech and Selma F. Goldsmith, Bureau of Agricultural Economics, Department of Agriculture, January 1946. 183 pages (mimeographed). The cash receipts from farm marketings include cash receipts from sales only, as calculated on a calendar-year basis. Write to the Bureau of Agricultural Economics, Department of Agriculture, Washington, D. C.

Ninth Biennial Report of the State (Oregon) Reclamation Commission—June 1, 1942–June 30, 1944. Report of the State Reclamation Commission, State of Oregon, made by Governor Earl Snell to the Forty-third Legislative Assembly, regular session, 1945. 21 pages (mimeographed). Write to the State Reclamation Commission, State of Oregon, Salem, Oreg.

Dynamic Factors Affecting Turbine Foundation Design, by Dr. Sergius Veselowsky, research department, the Detroit Edison Co., Detroit, Mich., at present with the Library of Congress, Washington, D. C., in *Electrical World*, August 3, 1946, page 60 illustrated. The author summarizes the practical considerations involved in the design of foundations for large turbo generators.

Summary of Industrial Electric Power in the United States (1939–46), a report prepared by the Division of Finance and Statistics, Federal Power Commission, 1946. 78 pages with illustrations. Report presents data on supply and use of electric energy by manufacturing, including Government manufacturing, and extracting industries for the years 1944–46, with text tables showing data for 1939–46. Fifty cents a copy from the Federal Power Commission, Washington, D. C.

"Precipitation Seasons in the United States," by Stephen S. Visher, in *The Geographical Review*, January 1947, page 106, illustrated. A graphic study of the four parts of the United States which have well marked seasonal contrasts in total precipitation. (The Geographical Review is published quarterly by the American Geographical Society, New York, N. Y.)

"The Birth of Mechanized Construction," by C. S. Hill, in *Engineering News-Record*, December 12, 1946, page 102. Illustrated. Mr. Hill, associate editor (retired) of the Engineering News-Record, traces the unprecedented progress made in the development of the construction machine and in the coordination of the operation of various types of such machines on a construction job.

"Prospectus on Atomic Power," by Prof. J. B. Condliffe, University of California, and others, a project of the Carnegie Endowment Committee on Atomic Energy, in *Electrical West*, November 1946, page 55, illustrated. A study by an eminent group of California scientists presenting a summary which suggests early arrival of electric power generating plants deriving their energy from nuclear fission.

Foreign Entries

Navigation on the Columbia River, in *Engineering*, London, England, June 21, 1946, page 590. Article emphasizes that the navigation of the Columbia River is of interest to Great Britain, since by the Oregon County Treaty of 1846, British subjects have the right to navigate the river to its mouth. The Columbia rises in British Columbia and the first 465 miles of its length lie in Canadian territory. Engineering is published at 35 and 36, Bedford Street, Strand, London, W. C. 2, England.

C. S. I. R.—1945, published by the Council for Scientific and Industrial Research, Commonwealth of Australia, 1945, 98 pages with illustrations. Annual report of the Council for Scientific and Industrial Research giving technical details of progress in the fields of plant industry, entomology, animal health and nutrition, soils, irrigation settlements, forest products, food preservation, fisheries, national standards, radiophysics, aeronautics, industrial chemistry, dairy products, lubricants and bearings, mining, and in scientific research and postwar reconstruction.

PAINTING FOR PROTECTION

by Graydon E. Burnett

Engineer, Branch of Design and Construction, Denver

The word paint is usually associated with making the old homestead white or the barn red. To Bureau engineers, paint means much more than just the opportunity to harness the colors of the rainbow. It is the commodity that protects millions of tons of iron and steel against the corrosive ravages of Mother Nature.

Eleven years ago the research headquarters of the Bureau in Denver established the paint laboratory for the primary purpose of ascertaining the best available coating for submerged metalwork. Through the years the scope of paint research has been widened to include paints and protective coatings for all types of construction, and for all sorts of exposure conditions. Penstocks, outlet pipes, gates, trashracks, and a seemingly unending array of miscellaneous metal work are given the ultimate in paint protection because of the research in the paint laboratory. This research is also an important factor in production time.

The laboratory investigations include everything from ordinary house paints to hot-applied, coal-tar enamels; from cold water paints to complex synthetic plastic coatings. The selection of the proper paint for a particular service has become an exacting problem, and one which requires precision testing equipment and specialized technicians for proper operation and interpretation of results. For example, paint is a feeding ground for molds, but adding the proper amount of germicides and fungicides during the manufacturing process forestalls damage to painted surfaces.

One of the more interesting pieces of equipment in the laboratory is the weatherometer. A sample of paint is applied to a square of metal which, after drying, is placed in the weatherometer. The sample is then subjected to successive water sprays and the glare of bright sunlamps. Thus, by making up a bit of rain or sunlight, the technician accurately determines the ability of the paint to stand up under destructive elements.

Other laboratory procedures and equipment include salt spray boxes which are in continuous operation as a means of evaluating the relative effectiveness and durability of proprietary paints which claim to be the ideal protective agents for metal work exposed to corrosive waters; apparatus to study the moisture resistance of protective coatings; a gage, called a reflectometer, which enables precise measurements of color, gloss, and hiding power of paints; and a thickness gage which accurately measures coating thickness to one-thousandth of an inch.

PAINT MEETS THE WEATHERMAN *in this tub known as the weatherometer.*

In addition to tests on finished dry coatings, the properties of liquid paint are of great importance as they influence stability, ease of application, drying time, and physiological effects.

Today the laboratory is searching for equipment to set up a small scale paint formulation plant where paint products can be developed which will be handtailored to suit any particular requirement. Accurate composition data will be available for incorporation in material specifications, and less reliance will have to be placed on purely physical tests to insure proper quality.

An important concern of the laboratory is the painting operation. Notwithstanding

(*Continued on page 72*)

ONLY THE BEST *in paint for Grand Coulee Dam.*

NEWS ROUND-UP

Generators and Turbines on Order

Contracts totaling more than a million and one-third dollars were awarded during January for power equipment on the Colorado Big-Thompson project. The contracts call for three turbines and three generators in the Estes Park plant, and a turbine and generator for the Marys Lake plant.

The Estes Park plant will be located on the south bank of the Big-Thompson River, about a half mile below the village of Estes Park, while the Marys Lake plant will be built two miles southwest of the Estes plant.

The plants are part of the Bureau's Colorado Big-Thompson project designed to divert Colorado River water from the western slope of the Rocky Mountains to provide a supplemental water supply for approximately 615,000 acres of inadequately watered land on the eastern slope. The ultimate total capacity of the project's power plants will be 175,000 kilowatts.

Recreational Surveys Planned

The Gunnison-Arkansas and Blue River-South Platte projects will be the latest locations for recreational surveys by the National Park Service as a result of a recently executed memorandum of understanding between the Bureau of Reclamation and the National Park Service. The estimated cost of $6,000 for the work will be transferred from the Bureau to the Park Service. This sum will be prorated between the Colorado River development fund and the Reclamation fund.

Parker Plant Gets Transformers

The power bottleneck at Parker Dam will be alleviated immediately through the loan of two 40,000 kilovolt-ampere transformers from the Corps of Engineers. These have been made available by Manhattan district engineer, Col. K. D. Nichols. The transformers at present are located at Oak Ridge, Tenn., and will be used at Parker pending completion of the new transformer bank.

Missouri Basin Investigations Get Cooperation

The Bureau of Reclamation, Bureau of Agricultural Economics, and the Montana State Agricultural Experiment Station are conducting a joint survey to determine economic conditions in connection with the joint Missouri Basin investigations under way. Under a separate agreement the Bureau of Reclamation and the Montana Agricultural Experiment Station will conduct a survey of piped and gravity irrigation methods.

Krug Announces Roza Openings

Secretary of the Interior J. A. Krug on February 14 at the Yakima-Tieton celebration (see p. 53 this issue) announced the opening to homestead entry of 1,722 acres of public lands on the Roza division of the Yakima project. There will be 28 units in the tract averaging 61 acres each. Public notices were sent to those who have indicated an interest in the opening. All applications must be filed with Superintendent D. E. Ball, Bureau of Reclamation, Yakima, Wash., by April 1, 1947.

Aid for Soldier Settlers

A Federal-State cooperative program is being set up to provide settler assistance to successful applicants on the Heart Mountain division of the Shoshone project in Wyoming. Buildings formerly used by war evacuees at the WRA center will be made available for conversion into living quarters by the new settlers. Agricultural assistance will be provided through arrangements with the Wyoming State Extension Service.

The Veterans' Bureau has notified the Bureau of Reclamation of its desire to provide vocational agricultural training for veteran settlers, and steps have already been taken to get this program under way on the Shoshone project.

Emergency Relief for Big Thompson

Assistant Secretary of the Interior Davidson recently approved a draft of a contract with the Northern Colorado Water Conservancy District providing for the construction of a temporary structure to carry water from the Alva B. Adams tunnel. This step was taken in order to meet the urgent needs of the lands in the Big Thompson Valley. The cost of the structure will be paid for by the Northern Colorado Water Conservancy District. The agreement covers the period beginning with the availability of water in 1947, and terminating as soon as the project has advanced far enough to permit delivery of water under the existing repayment contract between the United States and the district. The temporary contract will not amend or modify in any way the already existing repayment contract.

Testing Station Planned Near Imperial Dam

A permanent engineering station will be established near Imperial Dam by the Engineer Board of the United States Army, under the terms of a memorandum of agreement between the Interior Department and the War Department. The particular site chosen for the station contains all facilities required for testing equipment under conditions such as may be met anywhere in the world—controlled flow of water for testing floating and fixed bridges, swamps and desert. Lands in the same area were used for testing purposes during the war. The land where the station will be located was reserved for possible irrigation development but will now be released to the War Department.

Record Set at Anderson Ranch Dam

A new record for earth-placing was established at Anderson Ranch Dam recently, which ultimately will be the world's highest earth-fill structure of its kind. Over a 30-day period 377,000 cubic yards of material was placed in the dam which is located on the South Fork of the Boise River. This material is equal to a solid structure 500 feet long, 500 feet wide, and 40 feet high.

Provo OK's Increased Cost

A supplemental repayment contract which was approved by the Provo River Water Users Association early in December of 1946 was signed recently by Assistant Secretary Davidson. This contract represents the first offer by a water users association or an irrigation district to increase project costs which arose during the war years. Under the terms of the new contract the Association has agreed to an increased repayment obligation for construction of the Deer Creek division of the Provo River project from $7,600,000 to $11,400,000. (See February ERA, p. 44 for the story of Provo's prosperity.)

Bureau Engineers Loaned to Foreign Governments

Recognition among engineers of foreign countries of the Bureau's outstanding engineering achievements has been evidenced in requests that the Department of State is receiving from foreign governments for the loan of Bureau engineers and technicians.

(*Continued on page 71*)

Surveying From a Desk

by J. P. Smith,

Photogrammetrist, Branch of Design and Construction, Denver, Colo.

Through aerial photography only is it possible to survey this Colorado River region.

It was less than a century ago that such intrepid adventurers as John C. Fremont and Maj. John Wesley Powell took their surveying parties into the wilderness of the West where members of the parties suffered catastrophic privation, hunger, exposure, illness, and death.

Today, a survey can be made from a desk in a warm, comfortable office. This new science is known as photogrammetry—the art of obtaining surveys from photographs. Such surveys are obtained from the interpretation and treatment of aerial photographs. Through the use of photogrammetric processes, topographic maps for engineering purposes are compiled to any desired scale with contour intervals as small as 1 foot. Maps prepared by this method are being more and more widely used in Bureau of Reclamation work.

The work of photogrammetrists has proven to be an invaluable aid in geologic studies. The geologist uses a mosaic of aerial photographs as a base map, along with stereoscopic studies of paired prints, for preliminary investigations.

The study of landforms, drainage patterns, and distribution of vegetation, yields valuable clues to geologic conditions in proposed dam site and reservoir areas. Faults, landslides, location of bedrock outcrops, sequence of rock strata and other geologic conditions important to the engineer can be readily investigated by the use of photogrammetric processes allied with geologic principles. In addition, the nature of the problems and the areas of most profitable study can be outlined for subsequent field investigations.

A wealth of information is obtained by photogrammetric processes which might otherwise be neglected because of the large areas involved, the time element, and the high cost of ground surveying.

Working at a desk from photographs, the Bureau photogrammetrist prepares a detailed survey of projects under investigation such as the site for a dam, a reservoir, a power plant, or the routes of tunnels, canals and laterals. Photogrammetry is also used for related engineering studies such as determination of reservoir capacities, location of power transmission lines and roads, and classification of land.

The tremendous advances made in aerial photography and the interpretation of aerial photographs during the war have resulted in wider use of photogrammetry. The aerial photographer flies over a predetermined flight line using a special camera equipped with an auxiliary instrument known as the intervalometer; by means of a motor, the intervalometer operates the camera automatically, winding the film, setting the shutter, and tripping it at regular time intervals. Most aerial photographs are taken between 11 a. m. and 2 p. m. because at this time of day any shadows which might obliterate ground detail are reduced to a minimum.

An additional field of photogrammetry, which shows great promise, is the location of material deposits for construction purposes. The investigations made in this new field of application are now adequate to assure that the preliminary location of construction materials deposits by this method is a practical engineering operation.

The steadily increasing use today of photogrammetry in engineering and geologic fields is a logical development since this science provides many advantages over the arduous ground-surveying methods in (1) a saving in time of months, and in some cases even years, (2) a more thorough survey, (3) greater over-all economy, and (4) availability of data not obtainable economically by other methods.

Bureau Engineers Loaned

(*Continued from page 70*)

Mr. Albert W. Newcomer, engineer from the Design and Construction Branch in Denver, has been loaned to the Government of Venezuela to assist in the investigations of water resources and in the planning of irrigation projects. He arrived in Caracas in October and is to spend 1 year advising on American techniques and "know-how" in irrigation planning and construction.

It is expected that another Bureau engineer will soon travel to El Salvador to assist that Government with problems concerning hydroelectric power development on the River Lempa. This detail, which is to take about 3 months is now under discussion with the Department of State.

Additional requests for the loan of Bureau experts have been received from the governments of Venezuela, which desires a construction engineer and a geologist to assist in the design and construction of a water supply system for the city of Caracas; Costa Rica, which desires an irrigation engineer to help in the planning of a large irrigation project; Ecuador, which desires an expert in river silting problems to assist in the control of the Guayaquil River; Ceylon, which desires a Bureau administrator to accept the post of deputy assistant director of irrigation of Ceylon for a period of 5 years; and from Afghanistan which desires several engineers to assist in the planning and construction of large irrigation undertakings.

The services of United States' technical personnel are made available through the Department of State under authority of Public Law 63, Seventy-sixth Congress, which permits Federal agencies to loan personnel on a reimbursable basis to certain foreign countries, for a limited time. The country desiring assistance places its request with the State Department through diplomatic channels, and the State Department requests the appropriate agency to make its personnel available if possible.

Recent Project Maps

Published by the Bureau of Reclamation*

Panoramic Perspective of Boulder Dam Area. Map No. 47–3, supersedes No. 24550–A. Halftone. Size 7½ by 9⅜ inches, free.

Western half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 by 20 inches, free.

Orland project, California. Map No. 45–45 (supersedes No. 21880). Blue, green, and black. Size 8 by 10½ inches, price 10 cents.

Grand Valley project, Colorado. Map No. 45–40 (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 by 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52 (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 by 20 inches, price 25 cents.

Motion Pictures

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OUR BACK COVER

Friant-Kern Canal.

Construction on this "man-made river," begun late in 1945, is progressing. The first 75 miles of the 156-mile canal are now under way. The Friant-Kern Canal is one of the most important irrigation features of the Central Valley project and will supply water for thousands of rich but inadequately watered lands.

It will stretch from Friant Dam to Bakersfield, Calif., when completed.

Letters to the Editor

MANILA, REPUBLIC OF THE PHILIPPINES
December 13, 1946.

DEAR EDITOR: We are glad you resumed publication of the RECLAMATION ERA this year, and we shall appreciate the privilege of again receiving copies thereof in the future as we find them very valuable and interesting.

Very truly yours,
AMBROSIO MAGSAYSAY,
Manager, Metropolitan Water District, 176 Arroceros, Manila.

WASHINGTON, D. C.,
December 12, 1946.

DEAR EDITOR: The article in your November issue. "It Works Both Ways." by Mr. William E. Corfitzen, has been read with much interest and deep appreciation.

The Bureau of Reclamation has played no small part in the training programs we have administered for nearly 2,500 foreign technicians who represent 24 other countries. Mr. Corfitzen and his colleagues have been of splendid assistance in the successful operation of these programs for sharing American know-how, and we are grateful for his fine presentation of our work.

Sincerely,
ELLIOTT S. HANSON,
President, International Training Administration, Inc.

Painting for Protection

(*Continued from page 69*)

the care taken in the laboratory to choose the right paint for the right purpose, almost everything depends on the observance of good painting practices. In some cases a metal work must be subjected to sandblasting before the application of paint. It is sometimes necessary to apply primer coats. Very often paint is ineffectively applied because the surface was not properly cleaned, or the surface was damp at the time of painting, or the paint was improperly thinned.

An interesting sidelight to the Bureau painting problems is the fact that the irrigation farmer plays an important role in certain irrigated areas through his production of soybeans and flaxseed. The Department of Agriculture reports that three-fourths of the total soybean production in this country is crushed for oil. While, at the moment, soybean oil is being used in food production, paint manufacturers are planning extensive use of it when it is released for manufacturing purposes.

The next time you see a Bureau structure, remember the paint is not merely decorative but is the finest protective coating that constant research has made possible.

Notes for Contractors

Contracts Awarded During January 1947

Spec. No.	Project	Date of award	Description of work	Contractor's name and address	Contract amount
1495	Shoshone, Wyo.	Jan. 16	Transformers for Heart Mountain and Garland	Standard Transformer Co., Warren, Ohio	$55,170.45
[1] 1504	Boise-Payette, Idaho	Jan. 15	Transformers and switchgear	I-T-E Circuit Breaker Co., Philadelphia, Pa	21,289.00
1506	do	Jan. 8	12- by 13.38-foot fixed wheel gate	Consolidated Steel Corp., Los Angeles, Calif	19,575.00
1510	Altus, Okla	Jan. 2	Reconstruction of State Highway No. 9	Stebbins Construction Co., Tulsa, Okla	137,173.20
1511	Columbia Basin, Wash	Jan. 14	Transformers and registers for Grand Coulee	Westinghouse Electric Corp., Denver, Colo	18,201.00
[1] 1512	Boulder Canyon, Ariz.-Nev	Jan. 10	Construction of Coachella Canal, station 6106 to 6517	Otto Ashbach & Sons, St. Paul, Minn	697,724.00
1514	Central Valley, Calif.	Jan. 24	Completion of installation of penstocks 1, 2, 5	Eichleay Engineering Corp., Pittsburg, Pa	448,800.00
[2] 1519	Yakima-Roza, Wash	Jan. 14	Elec. equipment for areas 1–17	Railway & Industrial Engineering Co., Greensburg, Pa	10,370.56
1521	Boise-Payette, Idaho	Jan. 21	Elec. equipment for Black Canyon	General Electric Co., Denver, Colo	26,203.40
1523	Parker Dam, Ariz.-Calif.	Jan. 9	16 jacking units for floating bulkhead	Pacific Coast Engineering Co., Alameda, Calif	12,700.00
1524	Davis Dam, Ariz.-Nev.	Jan. 6	Construction of Phoenix-Tucson No. 2 transmission line	J & J Const. Co., Oklahoma City, Okla	475,165.31
1540	Boise-Payette, Idaho	Jan. 24	Clearing part of Cascade Reservoir site	W. D. Zavalas, Oroville, Calif	348,700.00
1544	Columbia Basin, Wash.	Jan. 17	Overhead traveling crane	Judson Pacific-Murphy Corp., San Francisco, Calif	19,171.00
1546	Gila, Ariz.	Jan. 24	Construction of laterals from A and B canals	V. D. Case Co., Long Beach, Calif	496,873.00
1560	Columbia Basin, Wash.	Jan. 16	11 stop logs for Grand Coulee	Lakeside Bridge & Steel Co., Milwaukee, Wis	29,800.00
1567	do	Jan. 29	Structural steel roof framing	Worden-Allen Co., Milwaukee, Wis	27,200.00
1582	Central Valley, Calif.	Jan. 28	5—15,000-pound radial gate hoists	Valley Iron Works, Yakima, Wash	14,350.00
R2–5	Region II, Calif.	Jan. 2	Moving buildings and constructing utilities	Paul H. Spencer Construction Co., Los Angeles, Calif	75,695.93

[1] Schedule 1. [2] Schedules 3 and 4.

Construction and Supplies for Which Bids Will Be Requested During March 1947

Project	Description of work or material	Estimated date bids to be invited [1]	Estimated bid opening date [1]
Boulder Canyon, Calif.	Trashrack handling equipment, Imperial Dam	Mar. 1	Apr. 4
Central Valley, Calif.	11.92 by 11.92 feet fixed-wheel gate No. 2, Friant Dam	do	Do.
Colorado-Big Thompson, Colo.	25-ton crane, Horsetooth Reservoir	do	Do.
Davis Dam, Ariz.-Nev.	125-ton gantry crane, Davis Dam and power plant	do	Do.
Rio Grande, N. Mex.	Revisions to spillway and channel, Elephant Butte Dam	do	Do.
Central Valley, Calif.	Circuit breakers in generator voltage bus, Keswick power plant	Mar. 3	Apr. 7
Boulder Canyon, Ariz.-Calif.-Nev.	Power transformers, oil circuit breakers, disconnecting switches, current and potential transformers for Boulder City water supply and Boulder City substation.	Mar. 5	Apr. 9
Rio Grande, N. Mex.-Tex.	Power transformers, oil circuit breakers, disconnecting switches, lightning arresters, and metering and relay equipment for Socorro substation and Elephant Butte power plant.	do	Do.
Ogden River, Utah	Earthwork, pipelines, and structures, laterals 13–1 and 17–1 and equalizing reservoirs 13 and 17, South Ogden distribution system.	Mar. 11	Apr. 15
Boise-Payette, Idaho	Generator cables for Anderson Ranch Dam power plant	Mar. 15	Apr. 18
Central Valley, Calif.	100-ton gantry crane, Delta-Mendota pumping plant	do	Do.
Columbia Basin, Wash.	Generator voltage bus structures for units R1, R2, and R3, Grand Coulee power plant	do	Do.
Do.	Power cable feeders to Grand Coulee pumping plant	do	Do.
Do.	6,900-volt switchgear addition to feed pumping plant, Grand Coulee	do	Do.
Do.	Construction Pasco relift pumping plants	do	Do.
Do.	100-ton trailer, Grand Coulee Dam	do	Do.
Davis Dam, Ariz.-Nev.	20-ton truck-mounted crane, Davis Dam and power plant	do	Do.
Klamath-Tule Lake, Oreg.-Calif.	Construction pumping plant G, Coppeck Bay area extension	do	Do.
Klamath-Main, Oreg.-Calif.	Construction Adams pumping plant	do	Do.
Missouri Basin-Kortes, Wyo.	Main control board and station service auxiliary power boards and miscellaneous bus equipment	do	Do.
Missouri Basin-Angostura, S. Dak.	7.74- by 7.74-foot fixed-wheel gate frame and anchorage, Angostura Dam canal outlet	do	Do.
Provo River-Deer Creek, Utah.	Construction Jordan Narrows pumping plant	do	Do.
Rio Grande, N. Mex.	Construction Elephant Butte-Socorro 115 kilovolts transmission line, 75 miles	do	Do.
Riverton, Wyo.	Earthwork and structures, Wyoming Canal, stations 883 to 1606, and laterals W–17.96 to W–29.89 and sublaterals	do	Do.
Yakima-Roza, Wash.	Construction pumping plants, areas 13 and 14	do	Do.
Do.	Construction 2.61 miles 13.2-kilovolt transmission line; 62.45 miles 34.5-kilovolt transmission line	do	Do.
Davis Dam, Ariz.-Nev.	Air compressors and associated equipment, Davis power plant	do	Apr. 22
Columbia Basin, Wash.	Canal lining and structures, main canal, stations 751 to 1101	Mar. 20	Apr. 24
Fort Peck Power, Mont.-N. Dak.	Power transformers, oil circuit breakers, disconnecting switches, instrument transformers for Circle substation	Mar. 28	May 2
Missouri Basin-power transmission lines, Nebraska.	Power transformers, oil circuit breakers, disconnecting switches, instrument transformers for Gering, Northport, and Sidney substations.	do	May 2

[1] Subject to change.

Photo. "Punch" Office.

FRIDAY NIGHT.

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APRIL
1947

In This Issue:

●

BENOCLOR 3-C

by
W. Harold Hirst

●

What is happening at the WRA centers on reclamation land?

See:
THE BUREAU RECLAIMS ITS OWN

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THE Reclamation ERA

United States Department of the Interior

J. A. Krug, Secretary

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The RECLAMATION ERA regrets to announce the death of David E. Ball (see page 54 of the March 1947 issue), Superintendent of the Yakima project, Region I. Mr. Olaf Lundgren has been appointed acting superintendent of the project.

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92 lower right	Stanley Rasmussen, Region I.
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96	William S. Russell, Region III.

Reclamation ERA

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Art work by James D. Richardson, Georgie Petty, and Mary Edmondson, Bureau of Reclamation, Washington, D. C.

"It's a fine thing for the Bureau of Reclamation to build great dams, and canals, and large power plants," said former Reclamation Commissioner Page, "but we must see that they serve . . .

THE PEOPLE

END OF THE RAINBOW. *They had to cross an ocean and almost a continent before they found a home and happiness at Tucumcari.*

THIS is a story about the people—people who are building new homes, transforming native, mesquite-infested range lands into cultivated fields—and other people, in a long-ago settled area, whose fears of recurring droughts have been banished; whose fields will remain green even though the rains fail.

Henry Batterman, his wife, Martha, and their children, Ella Mae, 9, and Dean, 6, moved to the Tucumcari, N. Mex., reclamation project, now under construction, in February 1946. Batterman could cultivate only a part of his 120-acre farm last year, but the income from this initial effort nearly equaled the purchase price.

There were others on this new project who did as well as the Battermans in their first year of operations. Among these were World War II veterans, Leo E. White, and

by Garford L. Wilkinson

Region V, Amarillo, Tex.

D. C. Atwood. But the Battermans' experiences are especially interesting. Motion pictures have been filmed around events less engaging than those woven into the lives of Henry and Martha.

The Battermans

Henry and Martha were born on neighboring farms in Germany. What might have become a childhood romance was interrupted when Martha Busing's parents came to America. Years later, after finishing trade school in 1928, Henry Batterman left for the United States in quest of freedom withheld from the German populace, even before Hitler's regime. When Henry's boat docked on the east coast, he went to Colorado. Martha's parents settled first in Kansas, moved on to Colorado, thence to Nebraska. Henry worked as a common laborer, later as a machinist, but the lure of the land was deep in his heart.

"I saw how American farmers used machinery to plant, cultivate, and harvest their crops, and I loved machinery," Batterman said, "but more than anything else, I wanted to be a farmer and enjoy the freedom of persons close to the soil."

In 1934, Batterman quit his job as a machinist in Colorado, and became a laborer on an irrigation farm in Nebraska. There, in Nebraska, he renewed his friendship with Martha Busing. In time, Henry and Martha were married. Batterman then became a tenant farmer on a place near Scotts-

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bluff. He worked hard and learned rapidly all of the intricacies of irrigation. Today, Henry and Martha and their children are enjoying the good life that comes to energetic irrigation farm families.

The Atwoods

D. C. Atwood was born and reared on an Oklahoma farm, where cotton was the cash crop. Year after year, Atwood, his wife, and the children planted cotton. Some years the yields were so poor, they scarcely "put a sack in the fields." Atwood figured he was lucky to grow a good crop and dispose of it profitably in 1 or 2 years out of 5. That is the type of farming that takes as much out of the people as it takes from the soil. Cotton to the back door—cotton to the front door. Tumble-down shacks, disease, poverty.

Atwood grew sick of body, tired of spirit, and he was restless. He was fighting a losing battle, and he knew it. But what can a man do when he's ill? It wasn't too far to Hot Springs, N. Mex. Perhaps the baths there would help some—maybe give a fellow time to rest and plan an escape from King Cotton!

On his way home, after a month's rest at Hot Springs, in 1944, Atwood passed through Tucumcari, N. Mex. Everybody was talking about the irrigation project being built there by the Bureau of Reclamation. Irrigation! What a contrast to the dreary, thousand-mile stretch of sand and cotton and cloudless skies where a man either cursed his ill-fortune; or prayed for rain.

The Oklahoma cotton farmer bought a tract of land in the project area, then headed his car down U. S. Highway 66; back to Oklahoma. He knew his family would welcome the news, and join in the dreams of life on a farm where water was available, the soil new and fertile. Atwood is a booster for the project's high, dry climate as well as its other attributes, present and potential. "I've gained 29 pounds since I moved out here," he said. "I can do a day's work for the first time in 20 years."

Strangely, Atwood still is a cotton farmer. There's something about growing cotton that gets hold of a man and won't let go. His first irrigated crop at Tucumcari averaged 1½ bales per acre. He believes he will make 2 bales an acre when the new land works a bit better.

The Tucumcari area is questionable for profitable cotton culture. Agricultural specialists are not encouraging its production and will remain skeptical, pending the results of additional experiments. The average frost-free dates are from April 20 to October 20, but King Cotton's Kingdom lies far to the south and east.

There is no gin at Tucumcari or nearby, so Atwood had to truck his cotton to Oklahoma. This would have been unprofitable, except for the fact that on each return trip to Tucumcari he hauled his married son's household goods and farm machinery. The son, J. J. Atwood, is renting a farm in the project area. Father and son hope to buy more land, in time. Moreover, they'd like to see many of their former Oklahoma neighbors settle at Tucumcari and share in the new life opening for the Atwoods.

Scores of families have purchased places in the Tucumcari project area; all are making progress. Eventually, the project will be settled by hundreds of land-hungry families.

OUR FRONT COVER

"IT SUITS ME"

D. C. Atwood, a dry land farmer for 20 years, finally lost his health worrying about crop returns because of droughts. After recuperating in the South, through a lucky accident he came across the Bureau's new Tucumcari project in New Mexico. That was the land for him. No more sleepless nights waiting for rain. Today, while he is not making too lucrative a living, it is at least a healthy and certain one, thanks to irrigation.

The Whites

Leo E. White, Wisconsin, born, reared in Texas, is another new farm-owning settler at Tucumcari. White comes from a long line of farmers. His father and grandfather moved from Wisconsin to Texas in 1916 to farm and regain his health. "Father's health improved," Leo recalls, "but he lost the seat of his pants growing cotton in the 'Lone Star' State."

White's urge to be a dairy farmer came during his high-school days. His vocational agriculture project involved a registered gilt and a cow. The gilt cost more than the cow. He lost money on the pig enterprise, but made good profits on the cow and its offspring.

After graduating from high school, White enrolled in an agricultural college. A boyhood friend, L. C. Strawn, another successful project farmer, wrote a glowing account of opportunities open to settlers at Tucumcari. White, accompanied by Strawn, inspected the range that some day, by the miracle of irrigation, would produce an abundance of beans, corn, tomatoes, carrots, peas, livestock feed, and permit diversified, live-at-home programs, including chickens, eggs, milk, cream, and butter, to support the major cash enterprises. White acted quickly. He purchased a site for his future dairy farm, then went away to war.

Leo E. White, vocational farmer, comes by it naturally. His grandfather and father before him were "men of the soil."

Returning to Tucumcari in 1946, White assembled a dairy herd, and today milks 25 cows with an electric machine. He keeps accurate, daily records. Any cow that fails to produce a profit is promptly sold. He believes he is getting more production, considering the grade herd, than any other dairyman in eastern New Mexico.

"When one of my cows gains one-tenth of a pound of milk, I feel like tipping my hat to her," White said. "A fellow can't succeed in the dairy business unless he enjoys it."

This project dairy farmer is building toward a pure-bred Guernsey herd, knowing it will be a slow process. The grade cows will work and build profits for their owner, who will eventually replace present animals with others having better blood lines and greater production possibilities.

The homes of Batterman, Atwood, White, and a majority of the other settlers on the project, are the homes of present-day pioneers. They were built to serve an immediate need. From hard work, water, and the soil will come better, more permanent homes later on. Pigs, cows, sows, and hens are supporting the major cash crops. Later on, truck gardens will also add to each family's food needs and bring additional income from the public market.

On another project in the Bureau's Region V, there are people who, for many years, have been farming the land on which they were born. Some years were good; some fair; some tragic. When the rains failed in July or August, potentially high yields either returned only their production cost, or crumpled completely in the sweltering wind.

The Walkers

Arnold Walker is farming the place in the 52,000-acre Lugert-Altus project, in Oklahoma, also under construction by the Bureau, that was homesteaded by his father and mother in 1904.

Arnold's father, P. W. Walker, was a "Master Farmer" in Oklahoma in 1927. He won the award over the State's finest managers and tillers of the soil, but Arnold remembers years when the Walker farm, like those around it in the semiarid region, failed to meet expenses. "I have seen our crops almost made," he said, "then we'd have a drought of several weeks and lose every stalk in the field."

In addition to farming the original 160-acre homestead, Arnold cultivates 80 acres in the project area owned by his sister.

The Lugert-Altus project lies farther east than any ever constructed by the Bureau. These lands have been in cultivation about 40 years. In dry years, farmers talked about an irrigation system. Today, their goal nears realization.

"I'd like the whole world to know," Arnold said, "that irrigation is the best thing that ever happened to me or my family since

Reclamation project farmers "eat high on the hog" year in and year out. The Walkers are no exception.

mother and dad were given a homestead here."

In 1946, for example, the first year water was available to the Walker farms, the land produced almost 1 bale of cotton per acre, despite an unusually late spring. Dry land cotton yield was poor. Arnold believes his irrigated cotton will yield from 1½ to 2 bales an acre in normal seasons.

The Southalls

Peyton Southall is another Lugert-Altus project farmer who received an initial water delivery in 1946. The 38-year-old former tenant grew sweet potatoes last year, valued at $415 per acre, an amazing return for a first year crop.

Southall was born and reared on a dry land cotton farm near the project. His experience up to the time he married, and for years after, were not unusual in any particular. "I rented a place to farm and worked for wages around the community when I could spare time from my crops," he said. "I had to work out to make a go of it."

In the 1930's, during the Nation's great drought and dust storm era, Southall worked for a farmer who irrigated from a small diversion on the Altus municipal water line.

(Continued on page 86)

Peyton Southall and his small son, Stanley, inspect sweetpotato crop made possible by irrigation.

When you see this milky-white mixture running through canals, it is time for water weeds to beware. . . .

BENOCLOR 3-C

by W. Harold Hirst,

Weed Specialist, Region IV, Salt Lake City, Utah

A CHEMICAL developed by a naturalized Belgian scientist to destroy heavy moss which caused two boys to drown while swimming on his New Jersey estate may open a new era in the life of western irrigators now pestered by water weeds that choke canals and ditches.

Widespread trials in the summer of 1946 throughout the intermountain area by Bureau of Reclamation weed control specialists produced results which have raised hopes of obtaining better control for water weeds. The tests were made with the chemical specially treated to make it effective in running water. Not only did the experiments prove its effectiveness, it also indicated that control may be achieved with comparatively little time, effort, and equipment.

The chemical is Benoclor 3-C. While the tests last year did not answer all questions about how it may be used, it did show that Benoclor works rapidly. Furthermore, the cost was far less than the average cost of other methods.

Benoclor 3-C is the result of work by Herman Seydel, the Belgian scientist, who discovered a chlorinated hydrocarbon he named Benoclor-3, about 10 years ago. He found that this chemical kept his ponds free of the moss, his main objective. The Salt River project in 1943 was the first Bureau of Reclamation project to use Benoclor. However, this chemical is heavier than water, and early trials in the running water of irrigation ditches, produced poor results. By adding an emulsifier, chemists found the chemical would form a fairly stable emulsion and could be carried for some distance in the water. The resulting combination was named Benoclor 3-C.

A sister chemical "Cloroben" is used on city sewage disposal systems and for reducing bacteria in the water at bathing beaches.

So far, there has been no proof that Benoclor has had any ill effects on crop plants, and according to tests made by the Bureau of Animal Industry, Department of Agriculture, the quantities needed to kill weeds in the ditches are not sufficiently great to harm livestock.

Although the principal experiments on Bureau of Reclamation projects in 1946 were made in region IV, Benoclor 3-C has been tried in other regions with varying results. Weed control specialists now feel that it is past the experimental stage, although results are being watched carefully and continued testing is planned so that the most effective operations can be developed.

Benoclor 3-C destroys the chlorophyll of plants. On canals successfully treated, weeds lose their color and take on a "cooked" appearance within an hour after treatment. Within a few hours after treatment the plants sink to the canal bottoms, and offer little resistance to the flow of the water. Within 24 hours after treatment, the plants begin to disintegrate and start floating down the canal. However, they do not clog gages, turn-outs or laterals as do weeds removed by mechanical control methods.

Plants which were effectively controlled included sago pondweed (Potamogeton pectinatus), Richardson's pondweed (Potamogeton richardsonii), blanket moss or string moss (Algae), water buttercup (Ranunculus species) and water weed (Anacharis canadensis).

There were variations in the results obtained. In all, data on 30 canals were analyzed. The results were rated as follows:

Poor—3 weeks' partial control or less before regrowth started. Three canals.

Fair—3 to 6 weeks' control before regrowth started. Ten canals.

Good—6 to 10 weeks' control before regrowth started. Fourteen canals.

Very good—complete control for the season. Three canals.

Irrigation canal **BEFORE . . .** *and* **AFTER** *Benoclor 3–C.*

Different quantities of chemicals per volume of water were used and length of treatment was varied so that a complete test could be made. Other factors which no doubt affected the results were density of vegetation, silt and mineral content of water, velocity of water, weed species, and maturity of plants at time of treatment.

These quantities of Benoclor per cubic foot of water per second (c. f. s.) applied uniformly over a period of 1 hour, gave the following results:

2.3 gallons per c. f. s.—poor.
3.5 gallons per c. f. s.—fair.
4.3 gallons per c. f. s.—good.

The volume of flow was found to be a more accurate means of determining the amount of chemical needed than the water surface width, used in earlier trials.

Application of the chemical for 1 hour was sufficient for average conditions. The figures quoted above were for the initial application. However, in many tests "booster" applications were made downsteam to maintain the original concentration. This additional application was made if the Benoclor "blanket" changed from its original milky color to a "skim milk" blue. Usually this change in color came after the "blanket" had run 1½ miles or for 3 hours, whichever was the shorter.

The Bureau of Reclamation's Chemical Laboratory at Denver, Colo., has recently developed a method for testing the concentration of the chemical in a canal to further improve the effectiveness of "booster" applications.

Actual cost records were kept on 27 canals with total length of 116 miles under treatment. The average cost per mile was $39.65. The average cost of other methods of control such as hand labor, dredges, disks, chains, and other mechanical devices, was estimated by managers of the canals at $96.91 per mile.

Equipment for applying the chemical consisted of a one-horsepower air-cooled gasoline engine; a half-inch vacuum gear pump of 3-gallon capacity; a 60- to 80-pound pressure bypass hose, a "neoprene" high-pressure hose to the manifold; an adjustable manifold of quarter-inch pipe upon which nozzles could be placed at 2-foot intervals, and screened, fan-type brass nozzles with orifices of $^{20}/_{1000}$ and $^{40}/_{1000}$ inch. (See the June 1946 *Era*, p. 117, for illustration.)

It is recommended to canal managers who may try the chemical this summer that the treatments should start when plants are growing vigorously and have just begun to retard the water flow. Use 5 to 6 gallons of Benoclor 3–C to each cubic foot per second of water applied uniformly over a period of 1 hour. Apply the first treatment for at least 60 minutes, although if the water has high velocity, the treatment should continue for 75 minutes. Booster applications should be made after the "blanket" has traveled 1½ miles, or when the color begins to change. Apply booster treatments through the length of the "blanket" in sufficient quantity to raise the concentration of the chemical to that of the first application. About 25 percent of the original application will probably be needed for the "booster."

Users are urged to keep accurate records on the capacity of the canal before and after treatment, width of water surface at time of treatment, volume of water, type and density of vegetation, turbidity and velocity of water, quantity of chemical used, time taken for application, and location of "booster" applications. By keeping such records, and forwarding them to the nearest regional office of the Bureau of Reclamation, information will be obtained which will help to perfect the method.

Effectiveness of the treatments is reported by Mr. Glen Bunton, of the Logan Northern Irrigation Co., Logan, Utah, who said that after treatment, the flow of water rose from 65 to 75 c. f. s., and by the next day, water which had been flooding over had receded enough so that water flow could be increased to 93 c. f. s.—equal to the maximum flow at any time during the season.

Not fishing—scientifically removing weeds.

It pays to advertise at these rates.

In Unity There Is Power

How a group of farmers on the Minidoka Reclamation project in Idaho obtain electricity and distribute it at one of the lowest retail charges for current in the United States.

by Barrow Lyons,

Chief Information Officer, Washington, D. C.

MANY OF the houses have no chimneys—yet there is warmth within.

Hydroelectric power is the answer. It provides heat, light, and power which is distributed at a low cost and made available to farmers scattered over 44 square miles of south central Idaho. The distributing organization is called the Unity Light & Power Co.—a good name, not only because it happens to be the name of a neighborhood in the district, but because it typifies the operations of the company and the farmers who made this cooperative a success.

This is the story of Unity.

The present secretary-treasurer of the Unity Light & Power Co. is Grant A. Dunford. He is also a farmer on 40 acres of the Burley irrigation district on the Minidoka project in Idaho.

The Unity Light & Power Co. was organized in 1917 as a stock company, but was changed to a cooperative on May 20, 1921, mainly because cooperatives were not taxed. When the company was organized, stock was sold at $10 a share. Each participating farmer bought enough shares to pay for the cost of his transmission line to the Unity substation at the rate of $100 a quarter of a mile. The farmer has to install transformers, meters, and secondary wiring at his own expense. Thereafter, the company maintains the primary line, transformers, and meters.

Dunford doubles in books.

That was when the consumers were quite widely scattered. As the years have passed this initial amount has been equalized by refunds so that the investment of each is now around $150, and the cost of membership in the cooperative is fixed at that amount. One of the reasons for this change was to bring in as many outlying farmers as possible, and make it possible also for virtually everyone who wished to join the cooperative. Not everyone could afford the initial cost at $100 a quarter-mile.

There are now 375 members of the Unity cooperative. They own about 90 miles of transmission line serving approximately 44 square miles of irrigated farms—something like eight-and-a-half customers per square mile.

In 1945 the cost of electric energy to the cooperative averaged 1.064 cents per kilowatt-hour. The electricity was delivered to the customers at an average of 1.909 cents per kilowatt-hour.

For the fiscal year ended November 30, 1945, the receipts of the cooperative were $19,091.21. Energy cost was $13,153.14. Operating expenses, including salaries of a manager, an electrician, and fees to mem-

Small electric heaters for active small fry.

K. C. Merrill cuts choice steak with aid of Minidoka power.

bers of the board, amounted to $6,576.78. There was an operating deficit of $638.71, which was made up by other income of $1,-266.19, such as interest on investments and sale of electrical equipment. This left a net income for the year of $627.48.

In 1944 there was a net deficit of $200.85. Mr. Dunford explained that the cooperative did not operate for profit, but to render a service to its members, so that a deficit was inconsequential, as long as it was made up another year. Generally there is a small profit. In 1943 it amounted to $1,154.64, in 1942 to $1,483.16, in 1941 to $940.35, and in 1940 to $728.17. Mr. Dunford looked back through his books to 1925—a period of 20 years. They showed, by a slightly different system of bookkeeping, that receipts had been $5,075.64 in that year, expenditures $4,253.31, indicating a net operating profit of $822.33. But uncollectible accounts amounting to $918.33 had been charged off, leaving a deficit of $96.

In 1925 the books showed total assets of $30,533.48. By 1944 these had increased to $73,902.79.

"We don't make a charge for depreciation," explained Mr. Dunford, "but we do keep our property in good shape, and charge the cost to maintenance; we do not consider this an actual depreciation of our property.

"The Bureau of Reclamation has just introduced a new rate structure. I have made a comparison with present rates, and I figure that under the new rate structure the cost to us will be about 40 percent less. I took our September bill to make the comparison. In September we bought 117,800 kilowatt-hours of energy at a new cost of $1,334.97. Figuring our demand charge under the new rates for 340 kilowatts at $306, and the cost of energy at $507, less a 3-percent discount of $82, I arrive at a total cost of $788.68, instead of the $1,-334.97 charged under present rates.

"Even under the previous charges, I felt free to use as much electricity as I wanted. All of the members use current very freely—just about as we use water. We know that all of the profits are going back to ourselves, too. What is more, the profits to the Bureau of Reclamation are used to reduce the construction charges of the project. The Bureau is paying me about $50 a year for owning land around here."

A year ago Mr. Dunford wired his house for electric heating, insulated it, and put on storm windows to conserve heat. He figured that heating by current from the cooperative would cost him with thermostat control about $50 a year. Houses require heating on the Minidoka project from the middle of September until the end of May—sometimes into June. Electricity, Mr. Dunford estimated, would cost him a little over $6 a month during the heating season.

This compared with approximately $10 a month for oil, or $8 to $10 a month for coal with a lot more labor. At the request of his interviewer he looked up his bills for the past 2 years and compared them. Electric bills from August 1944, through July 1945, amounted to $74.92. For the next 12 months his bills totaled $101.40—a difference of $36.48 which might fairly be attributed to the added heating load.

That brought his house heating cost to an average of $3 a month, or an average of $4 a month for the 9 months during which he required heat. Under the new rates even this will be reduced. Mr. Dunford estimates the cost of energy to the members of the Unity Light & Power Co. to average about 1.185 cents per kilowatt-hour.

Unless the whole picture is given, however, this is slightly misleading, because membership includes some fairly sizable establishments, which receive energy somewhat below the average on account of quantity consumption. For instance, the Y-Dell ballroom in which large parties are held, and which uses current for electric sign displays, consumed 1,652 kilowatt-hours of current in September 1946, at a cost of $18.92. A creamery owned by Herman Stoker used 5,950 kilowatt-hours in the same month at a cost of $59.75.

Mr. Dunford picked out the bill of an average farmer who paid in the previous 12 months $58.03 for his current, an average of $4.84 per month. Current was used for lighting and general farm work, including operating pumps and shop equipment.

Asked for more specific information as to what equipment the average farmer on the project used, Mr. Dunford produced an inventory he had made following a slight argument with James Allen, a resident

Ninety miles of transmission lines.

farmer and shareholder, over the burning out of a transformer. The question arose as to who was at fault for the mishap. Mr. Allen maintained it was not his fault. The cooperative declared he had overloaded his No. 3 transformer. The inventory showed the following equipment on the Allen place:

Electric range	Refrigerator
Air heater	Mixer
Water heater	Grinder
Electric welder	Radio in house
Electric iron	Yard light
Washing machine	Spud cellar light
Radio in barn	Electric fence
Milking machine	House lights
Toaster	Chicken coop light

Altogether, the cooperative figured, Mr. Allen's load was the equivalent of some 14,937 watts, and although not all of the equipment would be in use at the same time, it was enough to burn out any No. 3 transformer. A No. 5 was installed, although it is not certain this will be adequate. Mr. Dunford said that Mr. Allen's bill for 12,701 kilowatt-hours of current in the latest 12 months was $135.25—an average of $11.27 per month.

"When the Bureau of Reclamation built the Minidoka project it didn't think of using the power it generated, except for pumping purposes. When it was found that there was a surplus of current for the settlers, it applied the profits to reduction of the construction charges. When the construction charges are all paid out, the profits goes toward the operation and maintenance charges."

From April 1, 1926, to December 31, 1945, total of declaration of profits accruable to the Burley irrigation district totaled $1,719,880. These funds were applied as follows: $1,024,467 to the accounts of water users for the reduction of construction charges; $411,558 for increasing the capacity of the plant; $38,500 for the purchase of additional storage space in the Jackson Lake Reservoir; $93,932 to the accounts of water users for reducing operation and maintenance charges; $18,755 for an emergency transmission line to the Burley pumping station; and $132,648 unapplied but reserved for advance construction.

Current is sold to the towns and villages on the project, and they distribute it at a profit through their municipally owned systems.

In the fiscal year ended April 30, 1946, the city of Burley received from its municipal electric distributing system revenue of $184,678, and expended on that system $129,336, leaving a net profit of $55,342. In the last seven fiscal years its net profits amounted to $354,422, enabling it to make many civic improvements which would otherwise have been impossible. This has enabled the city to operate on a very low tax assessment.

The city of Rupert, also on the project, but considerably smaller, reports a profit from the operation of its electrical system of $229,720 during the twenty calendar years ended this year. It, too, has made many civic improvements on the basis of these revenues. In each instance the rates to customers are among the lowest in the Nation. Nearly half of the houses are heated by electricity. Many do not even have chimneys. The Minidoka project power rates have had a marked influence in bringing down the rates of private power companies in southern Idaho.

Towns in the area now have grown beyond the capacity of the Minidoka plant to supply current, and the problem of continuing to maintain rates as low as those in the past is one with which the Bureau is wrestling. In general, it has not been the policy of the Interior Department to encourage the payment of improvements by towns and cities out of surplus from the operation of electric distributing systms. The feeling is that citizens will profit more by the lowest possible electric rates—rates which will attract industry. Nevertheless, many municipalities prefer to use such surpluses for improvements or lowering the tax rate.

Electric welding cuts farm operating costs and labor.

International Engineering

EGYPT. It is understood that Mr. S. O. Harper, formerly chief engineer of the Bureau of Reclamation will serve on an international engineering board for the Egyptian Government. Other members of the board will include representatives from Sweden and Switzerland. The services of Mr. John L. Savage, Bureau consultant, were also sought but he was unable to accept the assignment due to previous commitments.

CHINA. The National Resources Commission of China, with which the Bureau of Reclamation has been dealing in connection with the Yangtze Gorge project, has been elevated to a ministry and is no longer part of the Ministry of Economic Affairs. The new office is directly answerable to the Executive Yuan.

VENEZUELA. Mr. Albert W. Newcomer, formerly of the Branch of Design and Construction, Denver, Colo., is now engaged in the investigations of the Tuay River Basin in Venezuela.

PORTUGAL. Mr. Fernando Vasco Costa, a professor from the University of Lisbon, Portugal, began studies of the Bureau of Reclamation's activities at Denver, Colo., during March. He is a State-Department-sponsored trainee.

The Farmers Take Over

With a salute to Yakima-Tieton farmers who paid the last installment on their debt to Uncle Sam, bureaucracy beats a retreat

IT WAS February 14, 1947, St. Valentine's Day.

The place was Yakima, Wash. The occasion, the "Tieton pay-off party," according to the banners festooning the streets. Lining the sidewalks were people who had come from all over the Pacific Northwest to watch the proceedings.

Secretary of the Interior J. A. Krug, Gov. Mon C. Wallgren, Congressman Hal Holmes, Chamber of Commerce, State and reclamation officials, along with the prominent Yakima-Tieton farmers and families. rode in a 75-car caravan, paying their respects to the first water-users' district to completely pay off, on time, its obligation to the Government.

As the cavalcade reached the rural schools, over 800 children proudly waved their signs, "Welcome, Secretary Krug," and when the Secretary stopped at one of the buildings, struck up their small band, following the music with a lusty school yell which they adapted for the occasion.

Of all the sights he witnessed, among them the cold-storage plants for the famous "Delicious" apple grown at Tieton, the apple processing plants, and orchards, the children seemed to make the greatest impression on Secretary Krug.

Following his tour of the Tieton division, Secretary Krug spoke at a "farmers' banquet" remarking that, from his observation, the outstanding contribution of the Yakima-Tieton Reclamation project was the hundreds of school children who turned out to greet the visitors. He had heard a lot about the apples and other crops produced on the Tieton plateau, but to his mind the future citizens in the schools on the project were its most lasting claim to fame.

In his formal address later in the day, broadcast through the Pacific Northwest at Yakima, Wash., Mr. Krug took as his theme, "Bureaucracy beats a retreat." Receiving the final check from Clifford Kail, president of the Yakima-Tieton irrigation district, he said, "When this check has been deposited in the United States Treasury, the farmers of the Tieton division will have paid the last penny of their debt of more than 3½ million dollars—the amount spent by the Bureau of Reclamation 37 years ago in building the irrigation system that waters your lands.

"Nowadays a $15,000 check arriving at the Treasury's receiving window does not cause any eyebrows to lift, and an expenditure of $3,500,000 on a Federal project does not seem especially large," said Secretary Krug. "The significance of this occasion is in what has been accomplished with that $3,500,000 investment.

Secretary J. A. Krug and friends.

"Some of you were here in 1910 when the Tieton area was a sagebrush desert about to receive its first water from the new canals. You have seen the Federal Government, through the conservation and use of the precious water resources here in the Yakima Valley, expand the national production, create $150,000,000 of new wealth, and provide homes for more than 1,000 families on 25,000 acres of land that formerly was not even good sheep pasture.

"Last year these Tieton lands produced crops of an average value of $750 per acre. Since they were first irrigated, each acre of this former desert has pumped new purchasing power of more than $6,000 into the arteries of our national commerce.

"Uncle Sam put his money into this venture under a wise law that was the keystone of the conservation program of Theodore Roosevelt—the reclamation law of 1902. This law has been supported by every administration since that time. It is not a partisan matter. Here on the Tieton division, Uncle Sam has now got his money back, dollar for dollar. In the meantime, the Treasury has sent its tax collectors to these former sagebrush mesas that now are dotted with apple and peach orchards. While I do not have the exact figures, it is clear that the Federal income taxes paid by farmers and businessmen who have earned their livelihood from these lands have greatly exceeded the cost of the entire irrigation project—a cost that has, in addition, separately been repaid in full by direct payments from water users."

Secretary Krug compared what has been done by irrigation in Yakima with what would have happened if in 1910 a barren island had been purchased by the United States for $3,500,000. Settled by our citizens, the Yakima-Tieton division has supported a thousand families in comfort and prosperity on farms, and even a greater number in the towns and villages that have grown up among them, he said, continuing with, "It does not stretch the imagination to compare an irrigation project with an island, since these projects are the only islands of intensive farming in vast unproductive expanses of the West which make up nearly half of all the land within the United States. They stand out in the sagebrush desert much as islands dot the sea."

"You men and women on the Tieton farms should be especially proud," said the Secretary. "This check for $15,000 is your final payment. Yours was one of the first irrigation districts established under the reclamation law and you have now carried out in full the contract made 37 years ago. This is the *first* final payment of all obligations by any irrigation district.

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It meant a lot to Tieton.

"You have changed the desert to verdant fields and orchards. Through the years, out of your earnings from the watered land, you have provided funds by your payments which the Department of the Interior has reinvested in other irrigation projects in the West. Several of these new islands of production which have been helped by the fulfillment of your contract are already the homes of new pioneer settlers. They, in turn, are beginning to repay their contractual obligations and will thus recreate and increase the reclamation fund for other new developments.

"I take pride in turning over this project to you—to your own elected officials, in order that it may continue to irrigate your farms under your direct control. Uncle Sam built the project. You have repaid his cost, and this irrigation system is now yours to operate and take care of. The Bureau of Reclamation will always stand ready to assist if you require help, but here is bureaucracy beating a retreat as planned. Here is the Federal Government, having extended a helping hand to its citizens, bidding them Godspeed, and withdrawing. Here is democracy creating vital projects which work for people, and then, when the task is done, leaving the people, strengthened and self-reliant, to carry on. That was Jefferson's way, expressed in his words, 'He governs best who governs least.'

"Reclamation has worked here in the Yakima Valley and it has worked in similar valleys through the West.

"Four million acres of irrigated land have produced 5 billion dollars in new American wealth. That partner of irrigation, hydroelectric power, created as a byproduct, serves industries, towns, cities, and farms with electric energy to improve living conditions for millions of people. The Congress wisely has authorized the expansion of the reclamation program so that it will reach twice the population now served. New irrigated lands and more power are to be made available in the years ahead in every State west of the ninety-seventh meridian.

"I agree with the western people who feel that true economy can best be achieved by completing these authorized projects speedily so that production will start paying back the Government's investment. Veterans are clamoring for a chance to clear the sagebrush and to farm these lands. They need living space now and a hungry world needs food. . . .

"In 1910, there were scoffers who said that the desert could not be beaten back and that the Tieton project would be a dismal failure. In 1947, the cynics who are the direct descendants of those same scoffers probably will contend that the new program for the Columbia River Basin will not pay out. They were doubtful that the power from Grand Coulee Dam would ever find a market. When the war came along and used this power, they said it would go begging when peace returned. But it hasn't: the tremendous demands being made on the Bonneville Power Administration which sells the power from Grand Coulee and Bonneville Dams conclusively proves that. The wartime peaks were surpassed in the fall of 1946, and now the demands are hitting new highs almost every week.

"What has been done through the construction of the great dams on the Columbia River toward the development of the Pacific Northwest, what you have done here in the Yakima Valley through the irrigation of the lands that were once desert, will be done again and again in communities yet to be established from the remotest creek at the Continental Divide to the mouth of the Columbia River at Astoria.

"The day will come when the final check of repayment will be delivered to the United States Treasury for all the developments on the Columbia River system. In that day and time, the Columbia River Basin will no longer be an area of undeveloped resources. It will have new millions in population. It will have great new factories and industries, and its agriculture, like the Yakima apple, will be famous throughout the world."

Adding significance to the occasion, Gov. Mon C. Wallgren proclaimed the week of February 10 as Reclamation Week for the State of Washington.

Director of the Branch of Operation and Maintenance, Goodrich W. Lineweaver, representing Reclamation Commissioner Michael W. Straus, presented the district with a certificate commemorating the event.

The formal transfer of the project took place March 1, 1947.

Name | Address

"Get Acquainted" Copies

If you have friends or associates who would be interested in the *Reclamation Era*, please list their names and addresses in the box to the left, clip and send it to the Commissioner, Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues so that they can get acquainted with your magazine.

Colorado-Big Thompson Project

Keeping Step With an Ever-Changing Economy, the World's Major Transmountain Water Diversion Faces a Future of Increased Benefits and Increased Costs

TEN YEARS AGO, Congress authorized the construction of the Colorado-Big Thompson project in the State of Colorado.

The main objective of this large scale multiple-purpose development is to combat crop losses due to irrigation shortages in northeastern Colorado. The Colorado-Big Thompson project has been authorized by Congress as an economically feasible engineering feat for transporting surplus water, which otherwise wastes away to the sea, from the upper reaches of the Colorado River on the western slope through the Continental Divide to the fertile, but inadequately irrigated, acres on the eastern slope of this great barrier.

When the Colorado-Big Thompson project is completed, it will collect and move this unused water far distances from the high country on the western slope of the Rocky Mountains under the Continental Divide via the Alva B. Adams tunnel to drop down the eastern slope toward the fertile area of northeastern Colorado, one center of which is Greeley, a town named for the renowned editor who urged the settlement of this area 80 years ago. It will insure and increase food production on 615,000 fertile acres now having a deficient water supply, and provide hydroelectric generating capacity of approximately 176,000 kilowatts in the process.

The major feature of this project was the drilling of a 13-mile irrigation tunnel—the longest of its kind in the world—through the Continental Divide—the backbone of the continent.

The story of how construction crews started simultaneously at the east and west portals of the tunnel and met each other in the middle, missing their calculations only by a fraction of an inch is engineering history, and a tribute to the soundness of the Bureau engineers' plans.

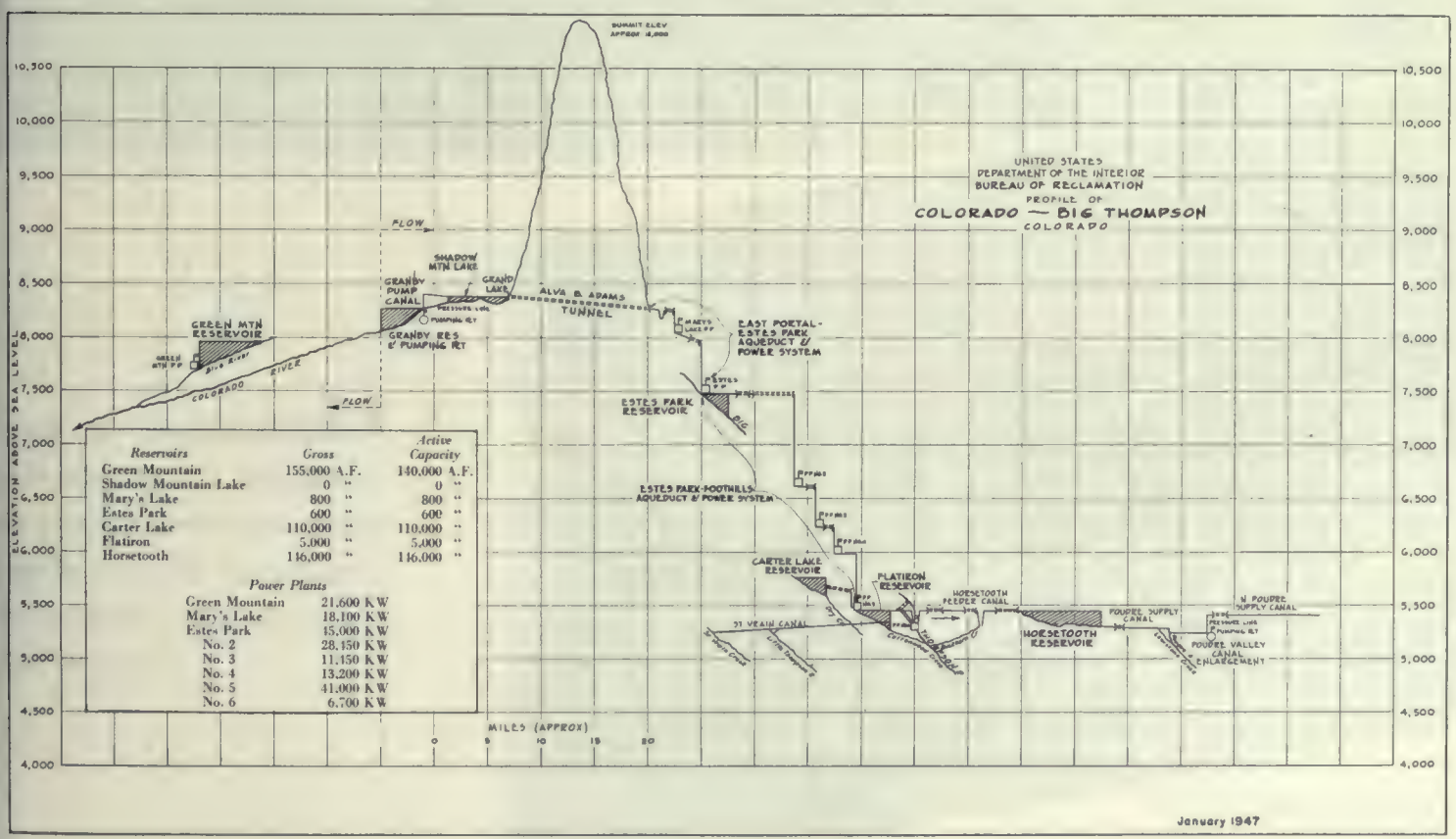
While the use of the waters for irrigation was the primary purpose of this feature, one of the most spectacular results to be achieved from the transportation of water through the Alva B. Adams tunnel is the creation of hydroelectric power. The profile drawing on this page shows the manner in which water rides through the tunnel, drops to holding reservoirs, and as it is released, generates hydroelectric power. Triple use of this water is made through irrigation, municipal water supply, and the power it guarantees for municipal, industrial, and rural electrification as well as to repay a large portion of the construction cost of the project.

Congress made initial appropriation for the Colorado-Big Thompson project in the Interior Department Appropriations Act of August 9, 1937 (50 Stat. 595), in accordance with the plan set forth in Senate Document No. 80, Seventy-fifth Congress. Finding of feasibility was approved by the President, December 21, 1937. The total expenditures on the project to June 30, 1946, were $26,387,750.

In 1937 only about $150,000 had been spent on preliminary investigations to pave the way for the actual construction, estimated at a cost of $43,000,000. As work progressed, improvements in preliminary plans were made to provide for the maximum development of a working partnership between irrigation and power.

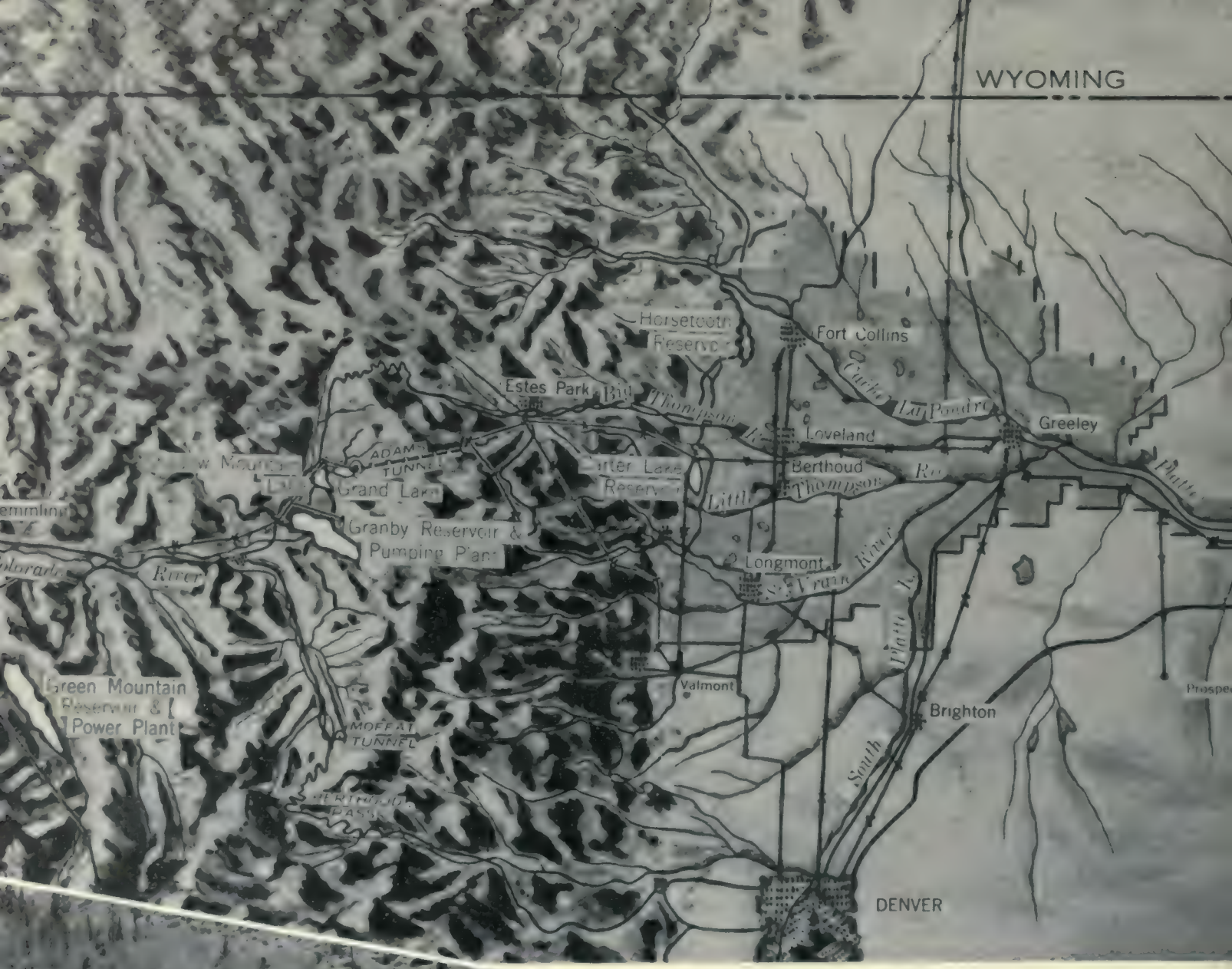
Since the project involved 19 separate but coordinated major engineering features, perfection of the preliminary plans involved

(*Continued on page 86*)



Reservoirs	Gross	Active Capacity
Green Mountain	155,000 A.F.	140,000 A.F.
Shadow Mountain Lake	0 "	0 "
Mary's Lake	800 "	800 "
Estes Park	600 "	600 "
Carter Lake	110,000 "	110,000 "
Flatiron	5,000 "	5,000 "
Horsetooth	146,000 "	146,000 "

Power Plants	
Green Mountain	21,600 KW
Mary's Lake	18,100 KW
Estes Park	45,000 KW
No. 2	28,150 KW
No. 3	11,150 KW
No. 4	13,200 KW
No. 5	41,000 KW
No. 6	6,700 KW



THE WEST PORTAL
OF THE ALVA B. ADAMS TUNNEL★

OPENING the way for fu
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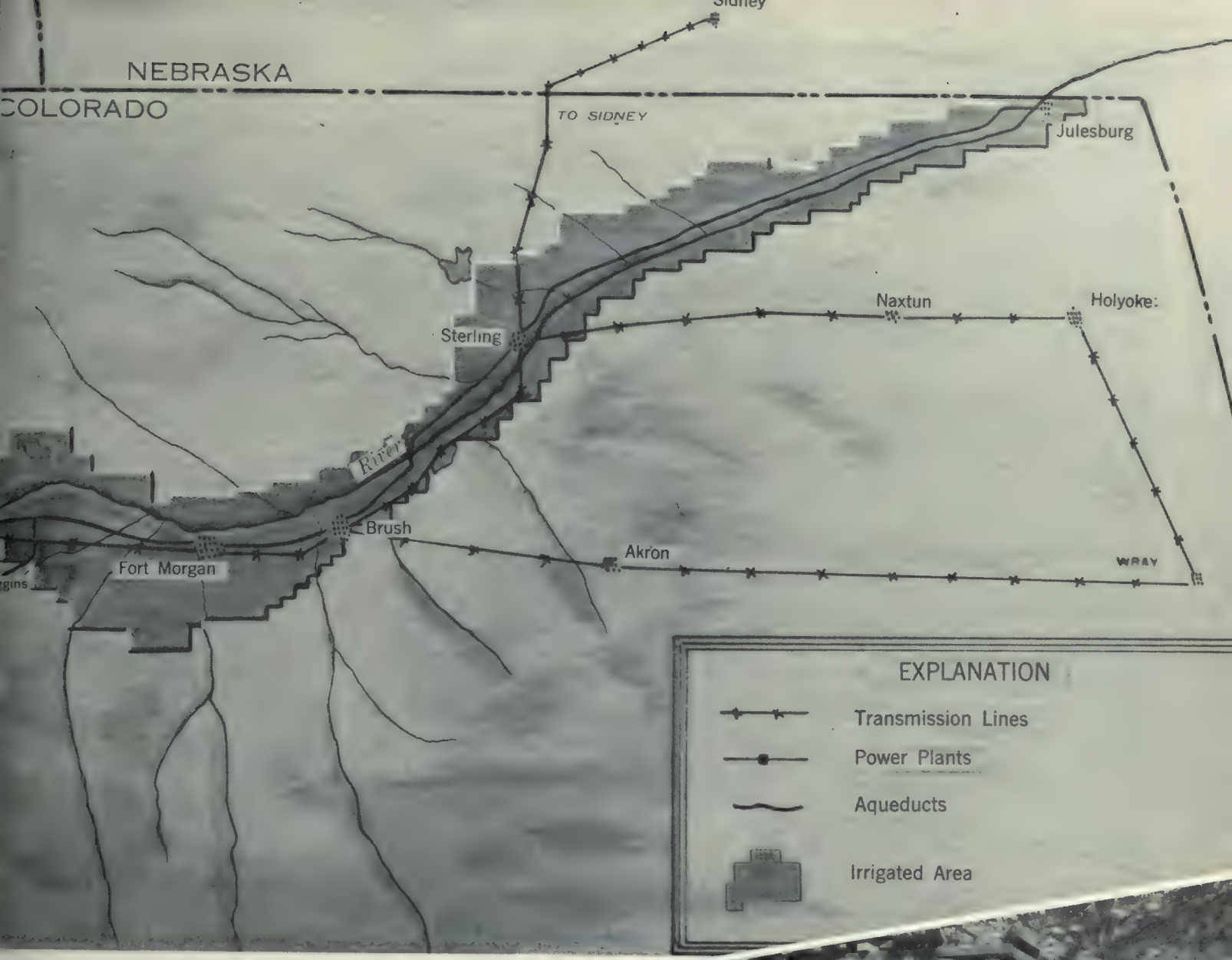
longest irrigation tunnel in the wor

★Originally called the Continental Divide t



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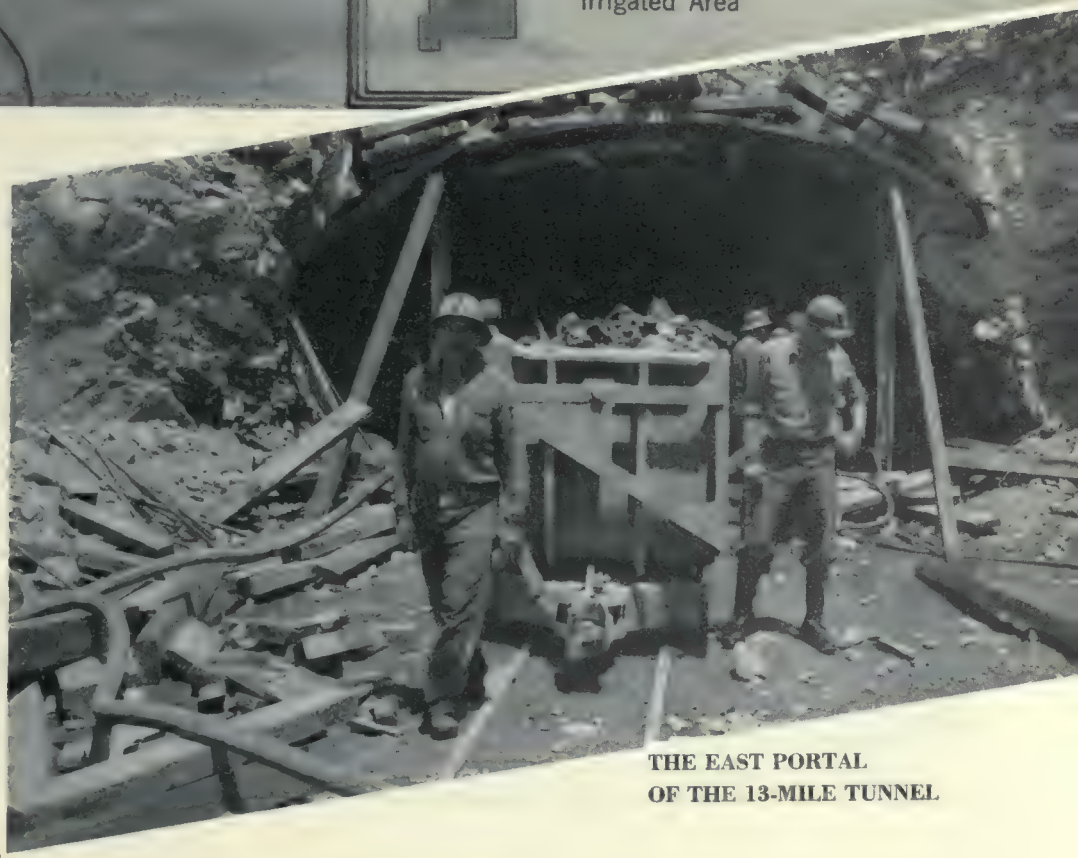


THE EAST PORTAL
OF THE 13-MILE TUNNEL

gh the backbone of the continent . . . . . .
1944 for the late Senator Alva B. Adams,
do

Colorado - Thompson Project

(*Continued from page 83*)

considerable study and investigation. In so doing, and after viewing the actual results brought about by the progress of construction, engineers found ways of making the Colorado-Big Thompson safer, more economical in operation, and more valuable to the water users, power consumers, and the people of the United States for whose benefit it is being built. The estimated outlay for the project increased from $43,000,000 to $128,000,000 on the basis of 1946 prices, due to the increased costs of wartime construction plus the prospective additional expenditures involved in revising and perfecting the plans.

The increases in project costs are paralleled by an increase in permanent benefits from the project as well as a decrease in annual operating charges over the years to come.

The long-standing policy of the Bureau of Reclamation and the Department of the Interior has been that water users are expected to repay the reimbursable costs, allocated to irrigation, of constructing a project, within the bounds of their ability to repay. On the basis of increased costs and in consideration of increased benefits, allocation of charges must be made to the extent of the ability of the water users to repay the increased costs.

The House Appropriations Committee on the Interior appropriations bill not only has concurred in this policy of the Bureau and the Department, but insists that increased construction costs must be reflected in supplemental, or amendatory, repayment contracts.

In the case of the Colorado-Big Thompson project, the increase in cost between the 1937 and 1946 estimates represents an increase in the cost of the irrigation features from $24,000,000 to $70,000,000, and an increase in the cost of power features from $19,000,000 to $57,000,000. On the basis of current estimates, increased benefits amount to over 1 billion dollars, representing benefits accruing to the water users, power consumers, and residents of the area from power revenue, additional agriculture, and recreational facilities.

Although the present estimates call for the entire costs to be repaid by irrigation and power revenue as construction expenditures are made, an appropriate adjustment on a fair and equitable basis between power and irrigation will be effected.

The 11-year span between preconstruction estimates and the present status of man's greatest movement of water through mountains has been marked by a world convulsion of prices and costs incident to the economy of war and recovery. During that period the project has proceeded with mandatory changes in schedules and optional improvements in plans.

Many improvements have been made in the project plans without altering the basic concept that was initially authorized and undertaken.

Some of these changes were necessitated by adverse underground conditions not indicated by preliminary explorations. Others have been made in plan and design to obtain greater reliability in operation and thus more nearly eliminate prospects of service interruptions to both the irrigator and the power consumer. While there is no change in the project's yield of water, the delivery program results in marked benefits to the users. Other modifications were made to render project power firm to a greater degree and increase its value and the revenues to be received from its sale.

These changes in plan have been discussed with the Northern Colorado Conservancy District, the construction agency for the repayment of the irrigation costs, the congressional committees, and have been publicized as developed. Some of them are already reflected in completed features of the project or works now being built for all to see. Others are fully described in outstanding advertisements for bids or in the specifications for work on which contracts have already been made.

The value of the salable power output has been materially enhanced by greatly increasing the proportion of firm energy available from the system, thereby increasing the resulting revenues required to pay for the project.

The power transmission system has been expanded to meet the demand for public power by cities, towns, and rural communities in northern Colorado. Among these are several existing municipally-operated power systems and several large and well-established rural electrification projects. In so expanding the transmission systems, the policy of the Congress that power shall be furnished preferentially to cooperatives and public agencies has been followed.

Long after the Northern Colorado Water Conservancy District has made the final payment to the United States for the construction of the irrigation works in this development, the State of Colorado and the Nation will continue to benefit from an ever-increasing source of tax revenues made possible by the project. The board of directors which heads the district is empowered to levy taxes by collecting a general tax, with limitations, on all property in the district to pay for the indirect benefits accruing to the district by bringing in project water, and by a special assessment on lands receiving direct water.

Reclamation on the Mississippi

At the last meeting of the Mississippi Valley Association in St. Louis, Mo., a resolution was passed proposing that the Reclamation Laws be extended to the entire Mississippi Valley. This would permit investigations to determine the possibility of reclaiming millions of acres of flood-depleted lands around the Mississippi River.

The People

(*Continued from page 75*)

"Irrigation sure made a good impression on me, especially in those years when it didn't rain enough to wash the dust off a hen house."

Tenant-farmer, wage-earner Southall held fast to a dream of all solid men of the land: he wanted to have a place of his own—a place a man could call home, and mean it. Eventually, he accumulated sufficient cash to purchase a sandy land cotton farm. Looking across distant fields, he saw the Bureau's construction crews building the Lugert-Altus project. "Nobody will ever know how much I wanted one of those irrigation farms," Southall said.

As time approached for irrigating the first unit of the project, Southall decided to make one final effort to buy a place where he would have water to nourish his crops when they needed it. He was successful, and now owns 69 acres just across the main canal from the Oklahoma State Experiment Station. He also farms 45 acres of leased land adjoining his home place.

There are five children in the Southall household, ranging from Melvin, 16, down to Stanley, 3. They are a wholesome lot. Melvin, for instance, has won numerous State championships in connection with his 4–H Club work. Among these awards was first place in the State farm level contest, sponsored by the Soil Conservation Service. Another time, Melvin was tops in the State contest for dairy judging, but some one failed to enter him properly, and he was denied the trophy. Melvin graduated from high school this spring. He will begin studying agriculture at Oklahoma A. & M. next fall.

All of the Southall youngsters, including 3-year-old Stanley, who helps (?) harvest the potato crop, gather eggs and feed the cats and dogs, have a pride of ownership in the project home. The older children raise chickens and pigs as a basis of their 4–H club activities.

Southall will continue to cash crop cotton, although he has a weather eye set for other strong supporting undertakings. A dairy herd is planned after the alfalfa fields mature. The potato acreage will be increased, and more land devoted to growing row crop livestock feed, both for home consumption and sale. Truck farming also appeals to Southall, who will expand this phase of the farm program to help supply local markets.

Books might well be written about the people who, for many years, have made comfortable livings on western reclamation projects. But there are other stories, no less interesting, yet to be told about the new settlers in presently developing reclamation areas. Man's urge to till the soil and work with nature is as old as civilization, for, trite though it be, it still is true that our "civilization begins and ends with the plow."

Opportunity Knocks Again

Purple Heart Veterans of World War II won't talk about their wartime awards, but you can't stop them when they start explaining their plans for farming the reclamation lands they won.

by Robert L. Branam

Region VI, Billings, Mont.

IN THE GLASS CHURN were 212 capsules. Each capsule represented the hope of a World War II veteran for a reclamation-created farm on the Heart Mountain division of the Bureau of Reclamation's Shoshone project in northwestern Wyoming. The date was February 4, 1947—the day set for the Bureau's second postwar land opening.

Veterans from 18 States of the Union wanted to take advantage of this opportunity. Wyoming, of course, had the greatest representation, next came Montana, and there were others from Nebraska, Colorado, Kansas, Oklahoma, Idaho, Utah, California, North Dakota, Minnesota, Oregon, Arizona, Arkansas, Michigan, New Mexico, Tennessee, and Washington.

In keeping with the Bureau of Reclamation's policy to make irrigable farm units available to veterans of World War II, it was appropriate that the highest-rated 212 applicants for the 83 farm units, containing 7,720 acres of irrigable land, were veterans, that the ceremony for establishing priority of award was conducted in the American Legion Hall at Powell, Wyo., and that names were drawn by post commanders of the American Legion and Veterans of Foreign Wars.

Preparations for the Heart Mountain opening began many years ago. In fact, all things considered, its real beginning goes back to the time of that colorful westerner, William F. (Buffalo Bill) Cody. For it was then that actual irrigation development was started on what is now known as the Shoshone project.

A monumental contribution to the Heart Mountain opening occurred in 1910, when the Shoshone Dam (now called Buffalo Bill Dam) was completed. But even this was only one event in the continued progress of the Bureau of Reclamation to make water available to the arid and semiarid sections of the Western States.

With the passing of the February 4 milestone on the Heart Mountain division, the Bureau picked up speed in the task of putting more and more land under the beneficial effects of a stable supply of life-giving water.

HOLD EVERYTHING, I'LL BE THERE IN A MINUTE!
said Pete G. Milohov as he heard the postman's whistle.

The actual process of opening the 7,720 acres of irrigable land to public settlement began October 3, 1946, when Secretary of the Interior J. A. Krug made official announcement of the event. The 499 applications received prior to November 25, 1946, the end of the period of simultaneous filing, were graded by an examining board composed of Fred O. Arnold and Edgar Swallow, both Powell, Wyo., businessmen, and

The postman brings his notice to appear before the examining board for personal interview.

Milohov paying required water assessments, which completes his filing with the Bureau of Reclamation for a farm unit.

Checking their farm unit on the map, the Milohovs are aided by Bureau officials Lloyd J. Klinger, left, and Alden S. Ingraham.

HOME WITH PAST AND FUTURE

Former internee camps—future veterans' homes.

RULERS OF ALL THEY SURVEY

Pete and the Missus look over the new property.

He's got what it takes. Through his own efforts in 1946 he was able to convert his profits into this valuable machinery.

All-American dog! Pete will take him along, of course.

L. J. Windle, superintendent of the Shoshone project. Top grades were given to 212 applicants.

Following the drawing in Powell, conducted to establish the order in which the 83 farm units were to be awarded, the applicants were called before the examining board for personal interviews to substantiate the claims made on their application forms as to capital assets, farming experience, character, and industry.

If he was able to complete the personal interview successfully, the applicant was allowed to pick out the farm unit he wanted most, in order of his priority. He then paid his water assessments and filed with the Bureau of Land Management for a homestead entry. As soon as his application was accepted by the Bureau of Land Management, he became a qualified homestead entryman.

To Ross Buchan of Powell, adjutant of the Hughes Pittinger Post No. 26, American Legion, fell the honor of selecting the first capsule from the glass churn. The capsule was opened and the folded slip of paper handed to A. J. Meyer, owner of station KPOW, Powell, a Mutual Network station. Over the air waves went the name of the winner of the No. 1 priority—Pete G. Milohov.

MILOHOV, 27, a homestead-born Purple Heart veteran, was working about his farm as usual on the momentous day. He first learned of his good fortune the night of the drawing when he read the *Billings Gazette*. The unassuming veteran tells that he and his wife, with the dubious assistance of their 6-month-old daughter Susan, scanned the list of priority standings. Checking off name after name they became increasingly disappointed. Then suddenly the name "Milohov" caught their eyes. It was part of the headline. There it was, so big they had not noticed it. Winner of first position for selection of a farm unit on the Heart Mountain division!

Milohov and his family spent the rest of the evening twirling the dial of their radio, reveling in the announcements of their good fortune, repeated and repeated in broadcasts from stations as far as the radio set could reach.

No stranger to homesteads, the prospective entryman helped his father, George Milohov, on a homestead in the Bull Mountains during his spare time while attending grade school at Pompeys Pillar, Mont. During his high-school days at the Huntley Project High School at Worden, Mont., he became more active on the homestead and was an enthusiastic member of the Huntley Project Chapter of the Future Farmers of America.

When the family moved to the Huntley project in 1938, his parents began operations on a 53-acre irrigated farm—acquainting Milohov with irrigation at an impressionable age.

Tragedy befell the family in 1939, when the father died. It was then up to Pete Milohov and his older brother Mike to assume the responsibility of operating their mother's farm.

In June 1944, Pete Milohov received "Greetings" from the president. He received his infantry training at Fort McClellan, Ala., and the following spring was sent to the Pacific theater. He first met the enemy in the campaign on Leyte. Practically noncommittal about his war experiences, Milohov tells that he was later sent to the island of Mindanao and shortly after meeting the Japanese, was wounded. He was taken to a hospital in the Philippines and later moved to the United States, being honorably discharged in October 1945. He holds, in addition to the Purple Heart, the Victory medal, Philippine Liberation medal, Asiatic-Pacific theater ribbon with two battle stars, and the Good Conduct medal.

As soon as he returned to the States, he stored the medals, donned work clothes, returned to the fields, and began preparing the soil for next year's crop. In the following spring he and his brother decided to expand their operations and rented approximately 200 acres from near-by neighbors.

The 1946 crop produced, in addition to always-needed experience, enough money to buy a complete line of farm equipment, which now will come in handy at his homestead on the Heart Mountain division.

Three days after the drawing, Milohov and his wife, Adele, traveled to Powell, where he completed his personal interview, selected his farm unit and filed with the Bureau of Land Management for homestead entry.

IN AN EFFORT to aid veterans in all ways possible, the Bureau of Reclamation is turning over the equivalent of two barracks buildings on the vacated Heart Mountain Relocation Center to veterans who want to use the material to construct homes and other farm buildings.

The Purple Heart veteran is already preparing for his move to the Heart Mountain division. His livestock is almost ready for the trip, and Milohov is making arrangements to buy more cattle for his new farm. In keeping with this trend, his two dogs, a female Springer Spaniel and a male Fox Terrier, recently became the parents of a curiously assorted litter. A couple look like their mother, one or two are definitely Spaniels, and the others take after their father, having a short-haired Terrier cast to their appearance.

Among other veterans whose names were drawn from the little glass churn in the Legion Hall at Powell was a hometown boy, Roy A. (Shorty) Myers. A native of Wyoming, Myers served in the South Pacific and for more than 1 year was listed as missing in action. Typically western, Myers is reluctant to show much concern about his experiences as a member of the fighting forces. However, he is eager—even anxious—to tell of his good fortune at the drawing and his many plans for the future.

ANOTHER homestead-born veteran on hand at the drawing was Huntington L. Downer, of Deaver, Wyo., whose father homesteaded in 1917 on the Frannie division of the Shoshone project. A member of the Navy air forces during the war, Downer was awarded two distinguished flying crosses and seven air medals.

Like Downer, Harry Thornton (Thorny) Ketchum is a native of the Shoshone project. Married and a father of a 6-month-old son, he is a third generation pioneer. The veteran of 30 months in the Pacific theater as a member of the Seabees was not discouraged even though 59 other names had been registered on the blackboard before his name was drawn. In fact he was pleased, for, knowing the Shoshone project like the palm of his hand, he knew that he would still have his choice of many desirable farm units on the Heart Mountain division.

During the ceremony that preceded the drawing, Kenneth F. Vernon, then assistant director of region VI, Bureau of Reclamation, reported that work was now under way to make additional homesteads available on the Heart Mountain division, beginning with the opening of 5,400 acres in 1947. As part of the Missouri Basin project, the Bureau of Reclamation plans to open many more farm units on what is known as Shoshone project extensions, he said.

In commenting on the opening of the Riverton project in central Wyoming, Mr. Vernon (appointed regional director on April 1, 1947) stated that approximately 10,000 acres will be opened for settlement in 1947 and approximately 50,000 acres in 1948 and 1949.

Mr. Vernon emphasized that the ultimate plan for the entire Missouri River Basin is the transformation of more than 5,000,000 acres of range and dry lands into 5,000,000 acres of the same kind of solid, steady, wealth-producing land contained in the operating divisions of Shoshone project.

The benefits resulting from utilization of the water resources in the Missouri River Basin will not only mean stabilized farm incomes for hundreds of thousands of people in the basin, he explained, but will result in a significant contribution to the economic wealth of the entire Nation.

Warne To Write Book on Irrigation

Assistant Commissioner William E. Warne has accepted an invitation to write a book on irrigation. The need for such a book was stressed in the invitation from the Science Editor of the Princeton University Press, Mr. Herbert S. Bailey, Jr. Former Commissioner Harry W. Bashore will review the manuscript which will be written in a popular style, designed to reach the general public. All plans are tentative, no publication date having been set yet.

The Bureau Reclaims Its Own

Free from the shadows of war, former war relocation centers have been given back to the Bureau of Reclamation, which is turning them into farms for veterans as quickly as possible.

by Carl J. Thye

Branch of Operation and Maintenance, Washington, D. C.

WHAT is happening at the three war relocation centers operated on Bureau of Reclamation lands?

At the Heart Mountain division of the Shoshone project in Wyoming, and the Tule Lake division of the Klamath project in Oregon-California, part of the land has already been turned over to veteran settlement activities, and on the Gooding division of the Minidoka project in Idaho, the Bureau is getting ready for the opening of the land to veterans of World War II.

Besides adding another item to its long list of public services rendered to the Nation in time of need, by making its lands available to the War Relocation Authority for providing shelter to evacuated Japanese during the war, the Bureau enhanced the value of some of the lands, and acquired considerable surplus property which is being made available to further Reclamation's veteran settlement program.

It will be remembered that, at the outbreak of World War II, the Justice Department apprehended and took into custody approximately 113,000 Japanese nationals and their American-born children. Of these about 39,000 were evacuated to centers on reclamation projects.

A total of 57,000 acres of Reclamation-withdrawn public land was turned over to WRA for camp-site and agricultural purposes. These included 1,100 camp-site acres, and 3,575 agricultural acres at Tule Lake; 1,294 camp-site acres and 1,843 agricultural acres at Heart Mountain, and 946 camp site and 784 agricultural acres at Minidoka. The remainder of the land was released to local ranchers for pasturing purposes.

Between April and July 1942, the evacuees began to arrive at the three relocation centers. At the peak of their capacity, Tule Lake sheltered more than 18,700; Heart Mountain almost 11,000, and Minidoka more than 9,000.

At first a memorandum of understanding between the Department of the Interior and the War Relocation Authority stipulated that the WRA would lease the land, pay for construction and land development, operation and maintenance of the irrigation systems, pay water rental charges, and make adjustments for lands which were made unfit for economic reclamation and productive cultivation as the result of the War Relocation Authority's activities. However, the Japanese internees made a definite contribution to the land development.

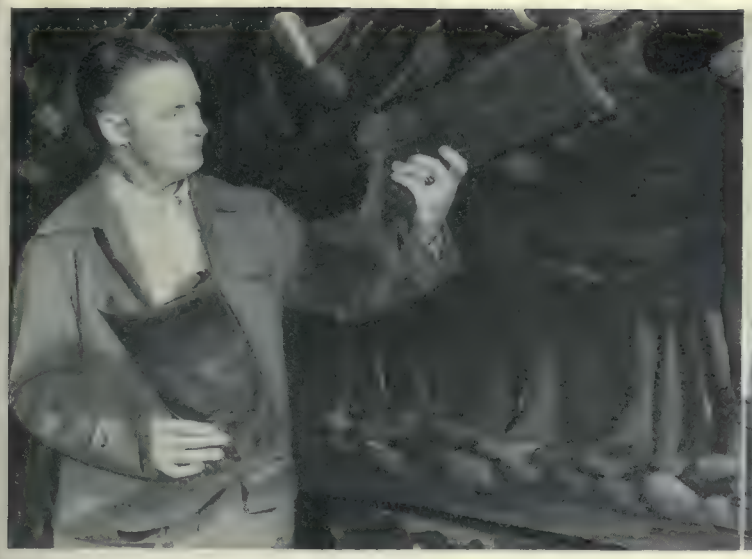
At both the Heart Mountain and Minidoka centers, they cleared and leveled the previously unfarmed land, constructed irrigation canals and other structures, including drainage ditches. At Heart Mountain, in order to get water to the land, it was necessary to repair the main canal from the Buffalo Bill Dam on the Shoshone project. At all the centers they improved the land and helped save crops by aiding in harvesting operations. WRA and the Bureau figured they came out even on the deal, so the original "memorandum of understanding" was canceled, and the mutual obligations were considered satisfied without exchange of funds.

With the lifting of west coast restrictions, the war relocation centers were closed by April 1946. The Bureau was free to reclaim its land, but was faced with the problem of using or disposing of the buildings, equipment, and supplies left on the centers.

The Bureau of Land Management, United States Department of the Interior, had been designated as the disposal agency to dispose of the land and buildings, and the War Assets Administration to dispose of the personnel property. Inasmuch as the land was under the jurisdiction of the Bureau of Reclamation, to aid in the veteran settlement program, Public Law 478, Seventy-ninth Congress, authorized the Bureau of Reclamation to acquire by transfer without exchange of funds, the lands, improvements, buildings, furnishings, and equipment which had been declared surplus at the three war relocation centers located on Reclamation lands. Under regulations of the Secretary of the Interior all of this property was made available to veteran settlers, nonprofit organizations and the Bureau, in connection with its construction, operation, and settlement programs.

As a result of this authority, there was constant activity in the centers last summer. Inventories were taken, buildings dismantled, renovated, or moved, supplies assembled, and the allocation of WRA property was begun.

The Bureau's policy is to use all the facil-



Only one of many necessities available to lucky vets.

Enough to keep 'em warm anywhere.

ities of the former WRA centers to advance the veteran settlement programs and to assist the existing communities in providing facilities needed to meet the increased demands of a growing population.

Three preference groups have been established to assure an equitable distribution. Group one includes the veterans who are or will be successful entrymen on public reclamation project land. Group two covers Bureau activities and its needs for providing necessary community facilities for settlers, construction workers, Government employees and others. Group three is made up of nonprofit organizations which can acquire property for uses beneficial to the development of the settlement program in the areas in which Reclamation projects are located.

Under this system 1,509 buildings have been set aside for veteran settlers, 1,300 for the Bureau, and 621 for nonprofit organizations.

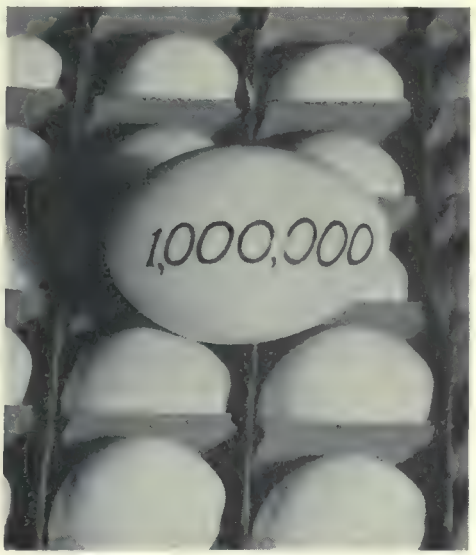
Veteran settlers are each entitled to two barrack buildings, 20 by 100 feet, which may be used for temporary housing or for building housing and farmstead facilities. The only charge to the veteran is that of removal to his land. Other materials to be made available to veteran settlers at no cost include heating stoves, beds, mattresses, blankets, hand tools, fertilizer and miscellaneous construction supplies of value to the settlers in developing homesteads.

Buildings taken over by the Bureau include those which are neded to conduct the activities of the Bureau on the project where the center is located or elsewhere. Among these are offices, shop buildings, and apartments for housing employees engaged in custodial maintenance of a center, and to expedite Bureau construction work directly related to present and future needs of the homestead program. Slaughterhouses, root cellars, refrigerated storage, and large warehouses will be utilized in connection with serving the needs of settlers and local farmers in the community and providing warehouses for the products they raise. The value of storage was apparent during the shortage of railroad cars in the summer of 1946, when all available space at the centers was used to store valuable crops which could not be shipped and would otherwise have spoiled in open storage. Apartment and dormitory buildings are being used to house custodial staffs and World War II veterans who are working on the projects or in nearby communities.

Group three—the nonprofit category—consists of State, county, or local government subdivisions or institutions, including local school districts, churches, public agencies, veteran posts, auxiliaries, Boy and Girl Scout troops, agricultural and other cooperatives, and organizations which would be concerned with the welfare of the settlers and their families and could contribute to the settlement program. School buildings

They were self-sufficient.

Millionth egg produced at Heart Mountain.



which used to welcome small Japanese children have in the past year accommodated neighborhood children, providing the critically needed additional classrooms for local grade and high schools.

Personal property allotted to the nonprofit organizations consists of sewing machines, cots, mattresses, blankets, school supplies, and books.

In what condition were these centers after more than 3 years' operation under the WRA?

Heart Mountain, Wyo., is typical of the wartime operations at a war relocation center on a reclamation project. This war-born community, created as the result of the Japanese evacuation program, was at one time the third largest town in the State.

Heart Mountain was not a prisoner-of-war camp despite the fact that the community was barbed-wire enclosed and certain restrictions were imposed upon it. Actually, the community of drab, tar-papered, squat buildings made a definite contribution to the community, State, and Nation during the war. With nearby agricultural communities suffering from the manpower shortage, evacuee workers volunteered their services in harvesting important crops, particularly sugar beets. More than once were the harvests saved by these workers alone, thus saving farmers literally millions of dollars and contributing to the war effort in the production of food.

The community also gave more than 700 of its youth to the Army, the majority of them serving with the famous 100th Infantry Battalion and the equally honor-laden 442d Combat Team. These two fighting outfits were the most-decorated small units in the entire United States combat services. Purple Hearts won by these two units numbered in the thousands, while seven of the Nisei soldiers were recommended for Congressional Medals of Honor. Distinguished Service Crosses were won by the score, while Silver and Bronze Stars were counted by the hundreds.

Attempts were made to establish in Heart Mountain as nearly a "normal" community as possible under wartime restrictions.

The community was to a large degree self-governing, with a community council, elected by and from the residents, as the controlling body. The council was supplemented by block managers acting in an advisory capacity for the residents of the 20 blocks in the community.

The school system corresponded with other schools in Wyoming, following the same curriculum and expressing the same interests in sports and social activities as other students "outside the fence." Despite their smaller physical size, the Heart Mountain high school football team was defeated only once in 3 years of competition—then by a team averaging 40 pounds more per man. The residents of the center supported a weekly newspaper, *The Sentinel*, which topped all other Wyoming weeklies in circulation. (It was printed by The Cody Enterprise.)

Heart Mountain had its own hospital, staffed, except for a Caucasian medical officer and head nurse, by evacuee doctors, dentists, nurses, and nurses' aides. Under a trust agreement by which profits were returned to the evacuees themselves, several merchandise stores handled unrationed foods, while barber, beauty, radio repair, shoe repair, and dry-cleaning shops offered services.

Heart Mountain was nearly self-sustaining as far as food was concerned. Before the center was closed, approximately 1,800 acres of once barren, sage covered land were brought into production. Preliminary work of clearing the land was begun in January 1943, the evacuees having arrived too late in the year to start any farm work.

Most of the farm experts among the evacuees were unaccustomed to the short seasons and rigorous Wyoming conditions. Few of them had ever had any contact with irrigated farming; consequently, considerable supervision (under Glen Hartman, region VI, Operation and Maintenance economist) was necessary during the first year of operation.

Potatoes, in production, led the list of 98 varieties of vegetables grown by the evacuee farmers. Other crops included daikon, a Japanese root vegetable, turnips, Chinese cabbage, sweet corn, cabbage, dry and green beans, beets, cantaloupe, lettuce, green and dry onions, green peas, radishes, romaine, cucumbers, rutabagas, spinach, squash, tomatoes, Swiss chard, bell peppers—and probably for the first time to be grown in that part of Wyoming, broccoli, egg plant, celery, and watermelon.

The first water brought to the Shoshone project for irrigation was the result of the evacuees' work. More than 200 of the farm crew workers lined the canal with bentonite, cleaned miles of canals and laterals before the first crops could be irrigated.

A starter-flock of chickens eventually provided all of the center's egg and poultry needs. Similarly, the hog farm, which started with 40 brood sows, supplied much of the meat consumed by the residents.

Social life was not unlike that found in other communities. Besides school activities, the residents participated in many church activities, the community supporting various Protestant denominations, one Catholic church, a Buddhist church, Seventh Day Adventist church, and the Salvation Army. Current events study groups, forums, Boy and Girl Scouts, the American Red Cross, USO, recreational programs for adults and children, and a score of other functions occupied the spare time of the residents. (*Continued on page 94*)

They beat the lumber shortage with their own mill.

Precious products available at the Hunt, Idaho, center.

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Approved Missouri River plan map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

2. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

3. *The Colorado River.*—Comprehensive departmental report on development of water resources of Colorado River Basin for review prior to submission to the Congress. Limited number of copies available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

4. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, seven-page mimeographed study with graphs.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 24, Agricultural Processing Industries—30 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Table showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

4. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

5. *Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945,* published January 4, 1946. Fourth annual financial statement of the Commissioner of Reclamation transmitted to the Secretary of the Interior concerning operation, maintenance, and construction activities of the Boulder Canyon project during the year ended May 31, 1945. Ten cents a copy.

Miscellaneous Publications

"Columbia Basin," by F. J. Clifford, in *Pacific Road Builder* and *Engineering Review,* December 1946, page 4. Illustrated. A comprehensive study of the history of the Columbia Basin in Washington State, with special emphasis on the construction of Grand Coulee Dam and the development of the Bureau of Reclamation's Columbia Basin project.

Missouri River Basin, a progress report of the Department of the Interior agencies participating in the comprehensive plan of development of the basin, prepared by the Missouri Basin reports staff, Billings, Mont., December 1946, illustrated, 54 pages (mimeographed), issued quarterly. Write to the Missouri Basin Reports Staff, Billings, Mont.

"Davis Dam Completes Storage Regulation of Colorado River Below Boulder," by L. R. Douglass, Assistant Regional Director, region 3, Bureau of Reclamation in *Civil Engineering,* January 1947, page 14, illustrated. The story of initial construction on the Davis Dam project—the largest undertaking by the Bureau of Reclamation on the Colorado River since Boulder Dam.

"Coachella Canal Advancing Through the Sand," by C. S. Hale, construction engineer, Bureau of Reclamation, Yuma, Ariz., in *Western Construction News,* December 1946, page 73, illustrated. Excavation and lining of the 141-mile Coachella Canal—main branch of the All-American Canal System—which will irrigate 80,000 acres of rich farm land in the Imperial Valley in California.

"Rural Electrification and Electroagriculture," by M. M. Samuels, Fellow, American Institute of Electrical Engineers, in *Electrical Engineering,* January 1947, page 20. A comprehensive study of rural electrification—the art and business of bringing electric service to the rural area and to the individual consumer in that area, and electroagriculture—the art and business of using electric power for farming.

"Designed by Savage," by Murdoch J. McLeod, in *Federal Science Progress,* February 1947, page 26. Illustrated. John Lucian Savage, designer of the Nation's giant dams, plans the largest yet—for the Chinese. *Federal Science Progress* was published monthly by the Office of Technical Services, United States Department of Commerce.

"George Hebard Maxwell," by Bryce C. Browning, in *American Forests,* January 1947, page 32. Illustrated. A brief biography of the beloved conservationist who died on November 30, 1946, at the age of 86. (*American Forests* is a monthly publication of the American Forestry Association, Washington, D. C.)

"New Road into the Utah Wilderness," by Charles Kelly, in *The Desert Magazine,* February 1947, page 10. Illustrated. The story of Art Chaffin—farmer, prospector, boat builder—the promoter and builder of a new scenic highway through the little known red-rock desert wilderness of southern Utah.

"A Basis for Planning Farm Implement House Layouts," by G. L. Nelson and W. G. Kaiser, senior agricultural engineer and manager, respectively, farm bureau, Portland Cement Association, in *Agricultural Engineering,* January 1947, page 15. Illustrated. As a flood of tractors and other equipment becomes available, farm machinery storage has become a most urgent farm building need.

Letters To The Editor

BAYFIELD, COLO.,
February 1, 1947.

DEAR SIRS: Attached hereto is a subscription for 1 year for the RECLAMATION ERA from the Bayfield High School and their check in the sum of $1 payable to the Treasurer of the United States.

Sending you this subscription gives me more satisfaction than any of the previous ones because of the fact that the magazine will be available to all the students in the Bayfield High School as it will be a part of their library.

The superintendent, Mr. Aaron A. Baker, is sold on the importance of reclamation.

S. F. NEWMAN,
Reservoir Superintendent,
Pine River Project.

WASHINGTON, D. C.,
January 16, 1947.

DEAR SIR: On the whole my comment on the RECLAMATION ERA is most favorable. I think it is a high-grade publication and should be very useful.

I would like to raise a question or two about the article "Homesteading—Then and Now" by Paul D. Olejar, which starts on page 10 of the January issue. If my memory serves me correctly, the mural by the late John Steuart Curry was based on the opening of the Oklahoma territory, April 22, 1889, and represented the "run" as it started along the Kansas border. The term "sooner" also developed at the time of the "run" into Oklahoma territory in 1889 when some of the settlers got into the land sooner than the others and sooner than the formal opening.

I think you will find this correct if you have time to investigate historical records or the story of the opening by Gittinger or statements in the encyclopedias. I will be pleased to have you advise if you find any evidence to the contrary.

Sincerely yours, JOHN B. EWING.

Editors Note:

Reader Ewing is entirely right. John Steuart Curry's mural, entitled, "Land Rush," was based on the 1889 Oklahoma territory land opening However, according to the "eye witness" account of the opening of the Cherokee Strip (also in Oklahoma) in 1893 (upon which the ERA's historical references were based), the illustration could well be adapted to either of the land rushes. "Sooners" were rife on both occasions. "Sooners" also were those who assumed that this use of the photographed mural would not be questioned.

No Disappearing Act

Several readers of the RECLAMATION ERA have wondered about James Robertson's overcoat. In his article, "The Magic Valley," appearing on page 47 of the February ERA, he stated, "Down by the Alamo, in old San Antonio, I lowered the car windows as far as possible, and removed my topcoat. I haven't seen it since."

No legerdemain was connected with this incident except that perculiar to printers, nor did Mr. Robertson imply dishonesty on the part of the people of San Antonio. The explanation is simple. The sentence should have read: "I haven't *worn* it since."

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

(Distributed from the Bureau of Reclamation Office, Washington 25, D. C.)

Boulder Dam	5 reels	(silent)
Boulder Dam	4 reels	(sound)
Reclamation in the Arid West	1 reel	(sound)
Fundamentals of Irrigation	3 reels	(sound)
Irrigated Pastures (Kodachrome)	2 reels	(sound)
Fighting Weeds (Kodachrome)	3 reels	(sound)
Measurement of Water (Kodachrome)	3 reels	(sound)

For Your Art Collection

Write to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue.* *This does not apply to photographs which carry outside credit lines.*

CONTACT PRINTS, single weight glossy paper, are available at the following prices *only if size of negative permits.* Most Bureau of Reclamation negatives are 8 by 10 inches.

	Selling price (each)
4 by 5 inches (or smaller)	$0.15
5 by 7 inches	.20
8 by 10 inches	.40
ENLARGEMENTS:	
4 by 5 inches (or smaller) single weight glossy	.25
5 by 7 inches single weight glossy	.40
8 by 10 inches single weight glossy	.60
11 by 14 inches single weight glossy	1.25
11 by 14 inches double weight mat	1.50
16 by 20 inches double weight mat	2.50
20 by 24 inches double weight mat	3.00
24 by 30 inches double weight mat	5.00
24 by 36 inches double weight mat	6.00
30 by 40 inches double weight mat	8.00
	Per sq. ft.
Over 30 by 40 inches double weight mat	$0.85

Single copies of the *ERA Available*

For the benefit of our subscribers and others who would like to purchase individual copies of particular issues of the RECLAMATION ERA, the following rates have been established:

	Cents
1 copy	15
6 to 9 copies	12
10 to 50 copies	10
50 or more copies	8

A limited number of back copies are available, except for the September 1946 issue.

*Make out check or money order to the TREASURER OF THE UNITED STATES and send request to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Please do not send stamps. For small orders, coins will be accepted.

The Bureau Reclaims Its Own

(*Continued from page 92*)

Because of the scarcity of lumber during the war, the War Relocation Authority installed a saw mill, which was operated by the Heart Mountain evacuees.

The mill was located about 35 miles from the center along the east boundary of Yellowstone Park, at an elevation of approximately 9,000 feet. The land was leased from the State of Wyoming. Eleven buildings were erected of unfinished native lumber to house the equipment and the evacuees who operated the mill. These buildings have been transferred to the Powell, Wyo., Girl Scouts, who will use them for summer camping activities. The sawmill equipment may be allotted to the Indian Service and perhaps moved from the camp in the spring to a new location somewhere in Utah.

Before the Heart Mountain camp was transferred to the Bureau of Reclamation last year, the War Assets Administration had disposed of most movable items and major equipment except for some hand tools and miscellaneous supplies, a small amount of school supplies, and a store of fertilizer. Thus the major assets at the relocation center when the transfer was effected were the buildings and permanent fixtures.

Contracts are now being executed to transfer, without cost, the school supplies to Wyoming educational institutions.

The hand tools and fertilizer are still in the possession of the Bureau, but will be acquired, without cost, by settlers on the Heart Mountain division and Riverton project who take up homesteads during 1947 and 1948. Present plans call for an even division of all tools and fertilizer to the settlers on both projects.

In Tule Lake, hospital equipment will be available to furnish hospitals in the area. Proposed plans to be submitted for approval call for a 50-bed hospital at Alturas, Calif., a smaller unit at Tule Lake, and if need arises, sufficient equipment and medical supplies are available to establish medical centers in the nearby towns of Merrill and Malin, Oreg., all of which serve the growing homestead area.

Far from becoming "ghost towns," the former WRA centers teem with activity, and numerous governmental and civic groups have coordinated their work under the supervision of the Bureau to pave the way for the incoming settlers.

Crop Returns Reach Half Billion

Preliminary estimates of 1946 crop returns from lands irrigated partially or totally by Reclamation facilities already exceed half a billion dollars. These estimates cover crops produced on more than 4 1/3 million acres in cultivation. During the year about 38,000 acres on nine projects received new water deliveries.

IRRIGATION IN SIAM

Modern irrigation methods made possible a contribution of over a million tons of rice to help combat world famine.

Kambhu prepares to report to his people on American irrigation.

IRRIGATION of rice fields in Siam is quite different from western United States irrigation, but the two have much in common. For contrast, there is the matter of rainfall—from 30 to 160 inches of rain a year in Siam; 3 to 20 inches on irrigated American lands. On the other hand, construction of impoundments and development of hydroelectric power are common problems which the Government of Siam wants to solve. Bureau of Reclamation works are being used as a model.

M. L. Xujati Kambhu, superintending engineer of the Royal Irrigation Department, Bankok, Siam, recently completed an inspection of various Reclamation projects. With his findings, he hopes to be able to tackle the engineering problems basic to Siam's production of food. For Siam's rice production is being counted on as one of the principal sources for combating world famine.

"Siam has given to the United Nations as a free contribution 156,000 tons of rice," Mr. Kambhu said. "From May 1946 to May 1947 she has taken upon herself the responsibility of providing the Rice Committee of the International Emergency Food Council with approximately 1,200,000 tons of rice for allocation purposes. This quantity represents practically 12 percent of the present-day world food shortage."

"Siam's ability to shoulder this responsibility is due in part to its modern system of irrigation," he said. Part of the crop is made possible by natural inundation of the central plain by the Choa Phye River. But climatic conditions are not dependable, and a dam is planned across the main river to stabilize and increase the crop yield through controls provided by a system of irrigation.

At present, Siam has no major impoundment dams, although 1,700,000 acres are irrigated by modern systems of ditches and diversions. Within the next 7 years it is planned to add 2,100,000 acres to irrigation.

Siam has heavy rainfall. This varies from 30 to 40 inches in the central portion to 100 to 160 inches in the western part. But the water supply is irregular—and rice cultivation requires 1,200 cubic feet a day per acre. Irrigation is needed to combat the prevalence of drought. Sixty-one of the last 114 years have been too dry for proper rice growth.

"I must say that all the works I have visited are of great interest to me," Mr. Kambhu said, "due to the fact that they have been carried on such a gigantic scale with great speed and yet are marvels of thoroughness, precision, and research. The main difference in irrigation works of the U. S. A. and Siam is that in the United States, hydroelectric power, flood control, and sometimes water communication, are amalgamated with irrigation, while in Siam only flood control and water communication have been combined with irrigation."

However, surveys are completed and a network of power generation to cover about three-fourths of Siam is planned. Some of the dams will be constructed in the near future.

"The average Siamese farm is 22 acres," Mr. Kambhu said. The average family consists of man, wife, and five children. A few farms are as large as 44 acres.

Aside from the heavy precipitation, the most interesting difference from the engineering standpoint is the flat terrain. The slope varies from 1 foot in a mile and a half to 1 foot in 30,000 feet—almost 6 miles. Soil varies from a few inches to about 2½ feet. Underlying this is a deep stratum of impervious blue clay. Although extremely hard to excavate, this clay makes exceptionally good lining for canals if left undisturbed. One of Mr. Kambhu's problems in the States was to find heavy earth-moving equipment that can handle this excavation.

Mr. Kambhu attended the Food and Agricultural Conference in Washington as a delegate from his country before starting his observation of irrigation works. He was accompanied by Ananta Chintakananda, secretary of the Siamese Legation. Visiting the Tennessee Valley Authority, he inspected the dams and works in that area, and later inspected rice fields in Louisiana and other works in Arkansas and Texas. On his Reclamation journey, Mr. Kambhu spent some time in the Denver office of the chief engineer before visiting irrigation works in the Southwest.

Kambhu, Chintakananda, and W. E. Corfitzen talk over world's highest dam.

NEWS ROUND-UP

Power and Irrigation—Partners

The Columbia Basin project was cited as a prime example of the fact that irrigation and power can work together as mutual helpmates in a recent speech by Operation and Maintenance Director Lineweaver at Ephrata, Wash. The speech followed the Yakima-Tieton celebration at which Secretary of the Interior, J. A. Krug, was the guest speaker, and Goodrich W. Lineweaver represented Commissioner Straus.

The Director said that the surplus waters of the mighty Columbia River could never have been diverted to the Columbia Basin project without the tremendous financial aid that power is giving to the repayment of the irrigation works. He said further, "The whole West can take a leaf out of the book being written here. The Bureau's program provides for the extension of the 'partnership' arrangement throughout the Columbia drainage basin and every other river basin in the West for comprehensive irrigation development."

He warned his audience against getting the wrong idea of development farms. "We are not planning to tell the settlers what to grow, or when, or how," he said. "We propose, together with these cooperating agencies (the Bureau of Plant Industry, Department of Agriculture, and the Extension Service), to make practical information available to the settlers in understandable terms. We are opposed to spoon-feeding settlers or to regimentation in any form, and our efforts are directed toward paving the way for the settler to succeed under his own steam."

In his talk he also referred to the Columbia Basin joint investigations which have been printed as individual studies and are now available to future settlers on the Columbia Basin project. (See p. 93.) He stressed the extensive research involved in the studies and expressed the hope that they would be read by all concerned, pointing out that these would go far toward assuring success and removing a great deal of the risk inevitably faced by future farmers who are not as fortunate in having available such comprehensive information as the Columbia Basin settlers.

Deschutes Slogan Winner

"Sagebrush to Clover" was Buzz Griffin's prize winning slogan describing the lands of the north unit of the Deschutes project in Oregon. The high-school freshman, son of Walter Griffin, one of the settlers on the the south county lands of the north unit, came up with this winning slogan as a result of his school's publicity contest at Culver to pick an appropriate name for the area. "Sagebrush to Clover," graphically describes the settlers program, namely the production of seed clover and alfalfa from formerly barren lands.

ARABIAN PRINCE VISITS AMERICAN KING OF POWER

"The desert, the dry weather, the unfertile soil, you have everything of ours here—but you have made it LIVE," said Prince Saud of Saudi Arabia (second from the right) on his recent visit to Boulder Dam. After completing a flying tour of the United States he said that the structure was the most impressive he had seen during his trip, "an incredible masterpiece of engineering which turned a vast desert into an Eden."

Veterans Get Priority for Columbia Basin Lands

Qualified veterans of World War II who now own Columbia Basin land, as well as qualified veterans who do not own land in the Columbia Basin area will be given A–1 priority for purchasing farms in this million-acre development. Secretary of the Interior J. A. Krug recently ruled that this preference is possible under the terms of the Columbia Basin Project Act and other authority. Others who will receive an equal priority in purchasing farms include nonveteran owners provided that they convey their lands to the United States in accordance with the terms of the Columbia Basin Act.

The Federal Government is now purchasing land in this project where construction of the irrigation works is well under way. The large blocks of land now being purchased will be divided into family-sized farms, assuring the best opportunity for the greatest number of people. The general policy of limiting water deliveries to ownership units not exceeding 160 acres of irrigable land will prevail. It is estimated at present that the average farm will be approximately 80 acres. The regional director's staff is now studying the specific application of this policy.

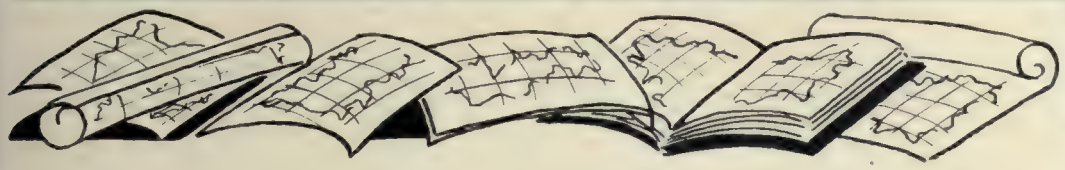
Orderly subdivision of the project lands can be speeded materially by release of entire tracts by landowners, who will still be assured of a farm after the lands have been divided. In this way they are given an incentive to sell their lands to the Government and through their cooperation bring about an earlier development of the area than would have been possible otherwise. Plans and studies which have been made of this vast project, known as "The Columbia Basin Joint Investigations," indicate that upon completion of the project, the total estimated population of the area will be increased to a third of a million people.

Topographic Maps Under Way

Commissioner Straus announced recently that topographic maps covering an area of more than 1,000 miles in the Feather and Yuba Basins in California are now in preparation. The work is being done under a joint agreement between the State of California and the Bureau. The maps will be used in making preliminary investigations, and later more detailed studies of irrigation works. Five counties, Nevada, Yuba, Butte, Sierra, and Plumas, are in the area to be mapped.

U.S. GOVERNMENT PRINTING OFFICE 1947

Reclamation's ATLAS



In ordering maps, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C. Please specify map number when ordering.

SMALL PROJECT MAPS

Showing Canals and Irrigable Areas

All-American Canal System, Calif., cld., 12½ x 17, #39–44—15 cents.

Belle Fourche, S. Dak., cld., 10 x 19, #23887—10 cents.

Boise, Idaho, cld., 11½ x 16, #42–3—15 cents.

Buffalo Rapids, Mont., cld., 11½ x 22, #40–48—15 cents.

Carlsbad, N. Mex., cld., 10 x 14, #23886—10 cents.

Central Valley, Calif., cld., 16 x 21½, #40–14—25 cents.

Columbia Basin, Wash., 10½ x 16, #39–84—10 cents.

Deschutes, Oreg., cld., 16 x 30, #43–1—25 cents.

Gila, Ariz., cld., 12 x 20, #39–93—15 cents.

Grand Valley, Colo., cld., 16 x 30, #45–40—25 cents.

Humboldt, Nev., cld., 10½ x 18, #40–54—15 cents.

Klamath, Ore.-Calif., cld., 16 x 20, #45–52—25 cents.

Kendrick, Wyo. cld., 10½ x 17, #24830—10 cents.

Lower Yellowstone, Mont.-N. Dak., cld., 10½ x 16, #46–30—15 cents.

Milk River, Mont., cld., 10½ x 24, #42–12—20 cents.

Minidoka, Idaho, cld., 8½ x 11, #23883—10 cents.

Minidoka-Gooding Division, Idaho, cld., 10 x 13, #23884—10 cents.

Newlands, Nev., cld., 10 x 13, #21444—10 cents.

North Platte, Nebr.-Wyo., cld., 10 x 20, #23510—10 cents.

Okanogan, Wash., cld., 8 x 10, #14424—5 cents.

Orland, Calif., cld., 8 x 10, #45–45—10 cents.

Owyhee, Idaho-Oreg., cld., 10 x 16, #23300—15 cents.

Rio Grande, N. Mex.-Tex., cld., 11 x 24, #19199—10 cents.

Riverton, Wyo., cld, 10½ x 17, #39–124—15 cents.

Shoshone, Wyo., cld., 10½ x 15½, #38–130—10 cents.

Shoshone—Garland Division, Wyo., cld., 10 x 15, #18988—10 cents.

Strawberry Valley, Utah, cld., 10 x 12, #46–16—15 cents.

Sun River, Mont., cld., 8 x 10, #27390—5 cents.

Tucumcari, N. Mex., cld., 10½ x 16½, #40–75—15 cents.

Umatilla, Ore., cld., 10 x 20, #21441—10 cents.

Uncompahgre, Colo., cld., 10 x 12, #23444—10 cents.

Vale, Oreg., cld., 10½ x 15½, #38–375—10 cents.

Yakima Basin, Wash., 10½ x 16½, #26376—10 cents.

Yakima-Sunnyside, Wash., cld., 12 x 23½, #40–77—15 cents.

Yuma, Ariz.-Calif., cld., 8 x 10, #2700—10 cents.

LARGE PROJECT MAPS

Showing Irrigation Canals and Laterals

All-American Canal System, Calif., cld., 22 x 30, #39–44A—25 cents.

Boise, Idaho, cld., 26 x 37, #41–25—25 cents.

Gila, Ariz., cld., 20 x 35, #39–93A—25 cents.

Minidoka, Idaho, cld., 17 x 22, #23883A—20 cents.

Minidoka-Gooding Division, Idaho, cld., 21 x 25½, #23884A—25 cents.

Newlands, Nev., cld., 21 x 27, #2144A—25 cents.

North Platte, Neb.-Wyo., cld., 23 x 44, #23600—25 cents.

Owyhee, Oreg.-Idaho, cld., 21 x 33, #23300A—25 cents.

Riverton, Wyo., cld., 22 x 36, #39–124A—25 cents.

Shoshone, Wyo., cld., 20 x 29½, #38–130A—25 cents.

Shoshone-Garland Division, Wyo., cld., 21 x 30, #18988A—25 cents.

Sun River, Mont., cld., 15 x 21, #27390A—10 cents.

Tucumcari, N. Mex., cld., 15½ x 25, #40–75A—25 cents.

Vale, Oreg.. cld., 21 x 31½, #38–375A—25 cents.

Yakima-Kittitas Division, Wash., cld., 21 x 33, #24770A—25 cents.

Yuma, Ariz.-Calif., cld., 14 x 16, #23328—15 cents.

SPECIAL MAPS

Average Annual Precipitation in United States, cld., 10½ x 15, #44–1—free.

Boulder Canyon Project, vicinity of Boulder Dam, cld., 22 x 30, #40–40—25 cents.

Boulder Dam and Power Plant, 8 x 10½, #27400—free.

Boulder Dam and Vicinity, Ariz.-Calif.-Nev., 8 x 10½, #26170A—5 cents.

Panoramic Perspective of Boulder Dam Area, 8 x 10½, #47–3—free.

Same—larger scale, cld., 22 x 30, #38–408A—25 cents.

Truckee, Carson, Humboldt, and Walker River Basins, Nev.-Calif., cld., 18 x 24, #38–408—15 cents.

Utah Projects, Utah, 10½ x 14½, #46–10—15 cents.

Western half of the United States showing Federal Reclamation projects and seven regional boundaries, cld., 16 x 20, #47–1—free.

Uncle Sam Says

This is getting-ready time for my farmer nieces and nephews. Today's plowing and investment in money and labor may or may not pay off in rich crops. There's a big IF in every farm family's life. If the sun shines, if it doesn't rain too much, if we have a drought—if, if, if. However, there's one crop which has no "if" side. It's a crop of Savings Bonds, which grows steadily, rain or shine, wind or calm, year after year until it produces $4 for every $3. My city nieces and nephews can plant this crop, too, by joining and staying on the payroll savings plan or by arrangement with their bank.

U. S. Treasury Department

EDITOR'S NOTE: The Inter-American Conference on the Conservation of Renewable Natural Resources, scheduled for Yosemite National Park May 5–18 has been indefinitely postponed. (See page 48, February RECLAMATION ERA.)

Notes for Contractors

Contracts Awarded During February 1947

Specification No.	Project and State	Date of award	Description of work	Contractor's name and address	Contract amount
1469 [1]	Altus, Okla	Feb. 4	9 radial gates for Altus dam spillway.	Johnson Machine Works, Chariton, Iowa.	$16,250.00
1519 [2]	Yakima-Roza, Wash	Feb. 5	Electrical equipment for various pump areas.	Standard Transformer Co., Warren, Ohio.	86,911.00
1525	Minidoka, Idaho	Feb. 18	Electrical equipment for Burley and Rupert.	do	44,673.00
1531	Tucumcari, N. Mex	Feb. 14	Construction of laterals, Conchas Canal.	J. A. Terteling & Sons, Inc., Boise, Idaho.	875,759.75
1548 [3]	Fort Peck, Mont	Feb. 6	Electrical equipment for Fallon and Fallon relift.	Standard Transformer Co., Warren, Ohio.	17,878.00
1562 [1]	Central Valley, Calif	Feb. 19	Aluminum stairs, railings, and curbs.	Seattle Bronze Co., Seattle, Wash.	28,526.00
1571	do	Feb. 6	Structural steel cofferdam	American Bridge Co., Denver, Colo.	171,855.00
1575 [4]	do	Feb. 25	Electrical equipment for Ygnacio and Clayton plants.	Westinghouse Electrical Corp., Denver, Colo.	16,206.00
1589	Deschutes, Oreg	Feb. 3	Construction of laterals and sublaterals.	Adler Construction Co., Redmond, Oreg.	165,300.00
1592	Yakima-Roza, Wash	Feb. 27	do	C. T. Malcom & Co., Portland, Oreg.	47,138.75
1593	Hungry Horse, Mont	Feb. 6	Construction of exploration tunnels at dam site.	Benson, Douglass & Bissell, Coram, Mont.	16,928.00
1594	do	Feb. 10	Finishing floors and painting 50 houses.	Puget Sound Painters Inc., Seattle, Wash.	13,090.00
1596	Boise-Payette, Idaho	Feb. 14	15-ton traveling crane and lifting beam.	Judson Pacific-Murphy Corp., San Francisco, Calif.	11,719.00
1603	Colorado-Big Thompson, Colo.	Feb. 18	Construction of Brush-Sterling-Holyoke lines.	Utilities Construction Co., Nashville, Tenn.	458,011.00
1605 [5]	Boulder Canyon, Calif	Feb. 14	Radial gates and hoists	Pacific Coast Engineering Co., Alameda, Calif.	13,070.00
1612	Davis Dam, Ariz.-Nev	Feb. 28	Construction of warehouse building.	W. S. Ford, Kingman, Ariz	129,965.00
1613	Yakima-Roza, Wash	Feb. 7	2 turbine driven pumping units.	The James Leffel & Co., Springfield, Ohio.	32,497.00
1614	Columbia Basin, Wash	Feb. 13	132 main unit trashracks	Joshua Hendy Iron Works, Sunnyvale, Calif.	36,300.00
1616	Parker Dam Power, Ariz	Feb. 21	Fabricated structural steel	Emsco Derrick & Equipment Co., Los Angeles, Calif.	34,563.00
1617	Central Valley, Calif	Feb. 28	Construction of timber bridge and weir, Fresno River.	Munn & Perkins, Modesto, Calif.	30,650.00
1635	Davis Dam, Ariz.-Nev	Feb. 20	15 bulkhead gate frames	Schmitt Steel Co., Portland, Oreg.	18,350.00
67,500-A	Missouri Basin-Gering	Feb. 21	Bare aluminum stranded conductor.	Aluminum Co. of America, Washington, D. C.	193,937.97
67,500-D	do	Feb. 21	Poles for Gering-Sidney transmission line.	J. H. Baxter & Co., San Francisco, Calif.	124,827.35
E 33,060-A	Central Valley, Calif	Feb. 28	Conductor cable for Keswick and Shasta.	General Electric Co., Denver, Colo.	74,428.51

[1] Item 1. [2] Schedules 1 and 2. [3] Schedule 1. [4] Schedule 2. [5] Schedules 2, 3, and 4.

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Vol. 33, No. 5

MAY
1947

Featuring:

●

A CENTURY OF IRRIGATION

by

Dr. John A. Widtsoe

●

WATER FORECAST

(*See;* "The Fortune Tellers," p. 113)

●

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THE *Reclamation* ERA

United States Department of the Interior

J. A. Krug, Secretary

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H. Wayne Fuller, Region I—Photos, p. 117, and p. 188 center.
A. W. Bauman, Region I—Photo, p. 118 lower left.
Norton T. Novitt, Region VII—Photos, pages 119 and 120.

Reclamation ERA

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Art work by James D. Richardson, Georgie Petty, and Mary Edmondson, Bureau of Reclamation, Washington, D. C. Drawings on pages 113 and 114 by Andrew M. Smith and Walter L. Lucas, engineering draftsmen, Washington, D. C.

NEWS ROUND-UP

Kings River Report Goes to Congress

President Truman has sent to Congress the War Department's report on the division of costs between the irrigation and flood-control features of the Kings River project, California. At the same time the Bureau of the Budget authorized the release of the impounded construction funds previously made available to the War Department so that the work could go forward. Secretary of the Interior J. A. Krug concurred in Secretary of War Robert Patterson's recommendations after a series of conferences to adjust differences. The War Department has agreed that the project will be operated initially for flood control only. Its operation for irrigation is dependent upon the negotiation of repayment contracts by the Bureau of Reclamation.

Colorado-Big Thompson Contract

With the award of the 4-million-dollar-plus contract for the Granby pumping plant, the water supply for Colorado-Big Thompson water users became a step nearer realization. This pumping plant will be built between Granby and Grand Lake, Colo., and will lift water into Shadow Mountain and Grand lakes to the Alva B. Adams Tunnel for diversion to more than 600,000 acres of inadequately watered lands on the eastern slope of the Rocky Mountains.

Contracts were recently awarded for the Brush-Sterling 115,000-volt and the Sterling-Holyoke 69,000-volt lines on the Colorado-Big Thompson project. The successful bidder was the Utilities Construction Co. of Nashville, Tenn., and the money involved amounts to almost half a million dollars. The Brush-Sterling line will be approximately 37 miles long and will run from a tap near Brush, Colo., to Sterling, Colo. The Sterling-Holyoke line will be approximately 48 miles long, from the Sterling substation to a substation near Holyoke, Colo. Aluminum conductor wire will be used in both lines.

Conchas Canal Nearing Completion

Contract for constructing laterals and building a 3.3-mile section of the Conchas Canal, Tucumcari project, N. Mex., was recently awarded to J. A. Terteling & Sons of Boise, Idaho. This marks the next to the last section of the canal to be built. When this section is finished, the job will be approximately 80 percent complete.

The work proposed will extend the Conchas Canal to the Hudson Canal. It involves the excavation of more than a quarter million cubic yards of materials, provides for placement of nearly 5,600 cubic yards of concrete, the installation of 15,400 lineal feet of concrete pipe, more than 240 tons of reinforcement bars, and other metalwork. The project will provide irrigation facilities for approximately 45,000 acres of land now generally used for grazing and some dry farming, and will provide irrigated farms for about 560 families.

OUR FRONT COVER

Cherub and Cherry Blossoms

Little Nancy Lee Davison, surrounded by these beautiful blossoms, is our idea of the perfect spring portrait. The youngster, whose photo was taken as she stood on a canal bank in the Emmett Valley, is the daughter of Mr. and Mrs. Dave Davison, of Emmett, Idaho. She may not realize it now, but the 83,500-acre area where she is taking up a minimum of space will eventually receive supplemental water from the Cascade Dam, a feature of the Boise, Idaho, project. This structure as planned will be an earth- and rock-fill dam approximately 90 feet high and 700 feet long.

(This timely photo was taken by Stanley Rasmussen with the aid of Phil Merritt, Region 1, on April 7, 1947.)

Economy in Action

The Bureau of Reclamation has recently ordered a universal testing machine for its laboratories in Denver, Colo. The new machine will be used for testing items used in construction which have unusual or complicated shapes. Engineers have expressed the belief that as much as 25 percent in the cost of some materials can be saved through more accurate testing. The machine will be of the vertical hydraulic type and have a capacity of 5,000,000 pounds in compression, and 5,000,000 pounds in tenson. Its cost is slightly in excess of $400,000 and will be built by the Baldwin Locomotive Works of Eddystone, Pa. In the past the Bureau used a smaller machine, the property of the Bureau of Standards, for some of the necessary tests, but it has deteriorated since its installation in 1931 and has proved inadequate for making a great number of the tests the laboratories were called upon to perform.

Fourth Veteran Land Opening

Applications were closed on April 25 for 43 public land farms embracing 3,226 acres on the Gooding Division of the Minidoka project in Idaho. Qualified veterans whose applications are approved will be given an added incentive in the form of a "bonus," to make good on this project. Each entryman will be entitled to two former barracks buildings free of charge from the evacuated War Relocation Authority camp in the area. These can be converted into living quarters and farm buildings. In addition to the barracks buildings, the center offers free personal equipment, including small tools, toilet fixtures, tables, chairs, sewing machines, army blankets, and other necessities of life.

This brings the total acreage of reclamation lands to be awarded by the Bureau since the war to 20,193 or a total of 240 farms for veterans. At Gooding, this is not all raw land. Some of it has been farmed by Japanese internes during the war. Future land openings proposed by the Bureau as soon as funds become available and construction progresses sufficiently, include additional lands on the Klamath, Oreg., and Shoshone, Wyo., projects, and public land on Yuma and Gila, in southwestern Arizona, and the Riverton project, in central Wyoming. Information on the availability of public and acquired lands can be obtained from the Commissioner, Bureau of Reclamation, Washington 25, D. C.

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Anniversary Issue

One year ago, with the May 1946 issue, the RECLAMATION ERA returned after a 4-year absence, voluntarily imposed upon itself as a wartime measure. No fanfare accompanied its revival. During the past year we have attempted to continue the high standards of editorial content, technical accuracy, and attractive format which distinguished former issues of this magazine since its inception in 1905. We have attempted to present useful and interesting information to persons concerned with the various aspects of the reclamation program, particularly the water users of the West. We have tried to include material which will be helpful in interpreting the policies and practices of the Bureau of Reclamation and assist the reclamation farmers in their important job of operating and maintaining their farms to their ultimate capacities. That we have succeeded to some extent is apparent by your many letters to us. However, we want to continue to improve this magazine, as reclamationists all over the world want to perfect their operations. Let us know your likes, your dislikes, your gripes, and your special interests. We will continue to be guided by your wishes—for this is your magazine, devoted to reclamationists here and abroad—and according to our mailing lists that includes a large audience, high school students, members of chambers of commerce, construction engineers, Congressmen, agricultural groups, sociologists, economists, and manufacturers. We want to hear from our audience—the boo's and the applause will help us adjust our performance to suit your needs.

—RUTH F. SADLER, *Editor.*

Single Copies of the *ERA* Available

For the benefit of our subscribers and others who would like to purchase individual copies of particular issues of the RECLAMATION ERA, the following rates have been established:

	Cents
1 copy	15
6 to 9 copies	12
10 to 50 copies	10
50 or more copies	8

A limited number of back copies are available, except for the September 1946 issue.

Make out check or money order to the TREASURER OF THE UNITED STATES and send request to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Please do not send stamps. For small orders, coins will be accepted.

Do You Plan To Move?

If so, please notify the *Reclamation Era* so that you may continue to receive your copy regularly.

Regional Director E. B. Debler, of Region VII, Denver, Colo., who retired April 30, was replaced by Assistant Director Avery A. Batson, who was designated acting regional director.

Letters to the Editor

Good Ideas From Engineers

2027 SOUTH WASHINGTON STREET,
DENVER 10, COLO.,
February 25, 1947.

DEAR EDITOR: Membership of our local No. 128, which is affiliated with the American Federation of Labor, consists largely of technical personnel of the Denver Office of the Bureau of Reclamation. As employees of this agency we are interested in promoting a better understanding of the work which the Bureau of Reclamation is doing.

It has been noted on several occasions at our regular monthly meetings that the RECLAMATION ERA has served very well as a medium for disseminating interesting yet factual information on activities of the Bureau.

Our organization is interested in sponsoring subscriptions to the RECLAMATION ERA. These subscriptions are to be sent not to individuals but to (1) colleges and universities from which our members graduated and (2) union locals throughout the United States who are affiliated, as we are, with the International Federation of Technical Engineers, Architects, and Draftsmen's Unions.

At this time we do not know how many subscriptions this program may require. However, I have been directed by the executive committee to inquire as to rates for 50 1-year subscriptions as a starter. In notifying prospective recipients of the ERA we will be happy to acknowledge any concessions made in subscription rates if you desire.

Very truly yours,

LYSLE L. DELONG, *Secretary,*
Denver Association of Federal Engineers and Architects,
Local No. 128.

¶Other organizations interested in reclamation, please copy!

RECLAMATION ERA'S subscription rate ($1 a year, special rate of 50 cents a year for members of water users associations) is already far below the price required for comparable publications. While this charge still exists, we hope similar plans can be worked out to boost the circulation of this magazine, which is published by and for reclamationists, and will grow or shrink according to the support you give it.—Ed.

Token From Texas

P. O. Box 447,
Ysleta, Tex., March 21, 1947.

DEAR MRS. SADLER: My husband and I wish to thank you for the very nice write-up we received in the March issue of RECLAMATION ERA. It was a splendid article and we appreciate it very much.

Yours very truly,

ELMA G. WARNOCK.
(MRS. FRANCIS J. WARNOCK).

¶Don't thank *us*. "Money-Making 'Mums'" (March 1947 ERA) caught the eye of many readers who became new subscribers, and the favorable comments keep coming in. The ERA is always on the look-out for interesting and useful articles like this on the experience of people on reclamation projects.—Ed.

Unofficial Ambassador

WEST YELLOWSTONE, MONT.,
February 24, 1947.

SIR: In a district in Norway, Nordtrondelag (of 52 communties, if I am right), as in many others, sufficient power is in harness by now to light, heat and power the whole "works."

To a paper there (of the same name) I have sent a correspondence every year or so, by way of a "hello, folks," and this winter, too, when I have a quiet hour, I shall repeat. I have fancied that those parts might like to hear about power developments in the United States, a letter which would be the more welcome if accompanied by a cut or two. Could I have your permission to cut out, say, the "before and after" illustrations of the Black Canyon and Boulder Dam, appearing in the RECLAMATION ERA, for reproduction in the mentioned district paper, of course giving source and credit?

Norway now looks forward to the day when she will be able to export power to Sweden, Denmark, and even England after her own needs are met, and is working at it as fast as her breath holds out. Without the waters around it, and running down it, that little country's fate would be sealed and laid away.

All my thanks for giving consideration to this peculiar request.

Respectfully,

H. T. BERG.

¶Request not peculiar, but typical. ERA's photographs are gladly forwarded for reprinting—especially for such a worthy cause as helping to forge another link in the chain of international cooperation on matters pertaining to reclamation.—Ed.

For Your Art Collection

Write to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue. *This does not apply to photographs which carry outside credit lines.*

CONTACT PRINTS, single weight glossy paper, are available at the following prices *only if size of negative permits.* Most Bureal of Reclamation negatives are 8 by 10 inches.

	Selling price (each)
4 by 5 inches (or smaller)	$0.15
5 by 7 inches	.20
8 by 10 inches	.40
ENLARGEMENTS:	
4 by 5 inches (or smaller) single weight glossy	.25
5 by 7 inches single weight glossy	.40
8 by 10 inches single weight glossy	.60
11 by 14 inches single weight glossy	1.25
11 by 14 inches double weight mat	1.50
16 by 20 inches double weight mat	2.50
20 by 24 inches double weight mat	3.00
24 by 30 inches double weight mat	5.00
24 by 36 inches double weight mat	6.00
30 by 40 inches double weight mat	8.00
	Per sq. ft.
Over 30 by 40 inches double weight mat	$0.85

Main Street, Salt Lake City, 1861.

Scene, the same—time, the present.

A CENTURY OF IRRIGATION

by Dr. John A. Widstoe

THE ANCIENT ART OF IRRIGATION celebrates this year (1947) the hundredth anniversary of its modern birth in North America.

Irrigation was practiced on this continent in prehistoric days, as abundantly shown by the remains of ancient irrigation works. In later days, after Columbus, some native irrigation continued, and the Catholic padres, knowing irrigation from their Spanish days, set up irrigated missions, as in California, to assist them in their missionary activities. Up to 1847, however, all irrigation, except for an occasional ranch, was for primitive people, conforming to primitive needs.

The Mormon pioneers who entered the Great Salt Lake Valley in 1847, belonged to the civilization that Anglo-Saxon peoples had won for themselves through centuries of struggle. The gains of that civilization they must maintain. The stark desert must be subdued, but not at the price of civilized life and living. Somehow, they must hold on to the social, economic and spiritual possessions on the conquered desert as well as they had in humid regions. That was the challenge to the pioneers of 1847—to build communities of modern, civilized people under the ditch, comparable or superior to those in the rainfall regions from which they came. That accomplishment is in mind when we speak of modern irrigation.

So, within a day of their arrival, they led water from City Creek to a patch of plowed ground, and planted a bushel of potatoes. The pioneers needed food. Would the desert yield it? That was their question. They did not realize that when they made that miniature ditch that day, they created an epoch-making event in the history of the United States, and for many a far-flung country. It was the infant beginning of the later mighty dams and canals that now make the western United States a fortress of strength in the union of commonwealths. That thrilling moment may well be celebrated by poet, painter, and sculptor.

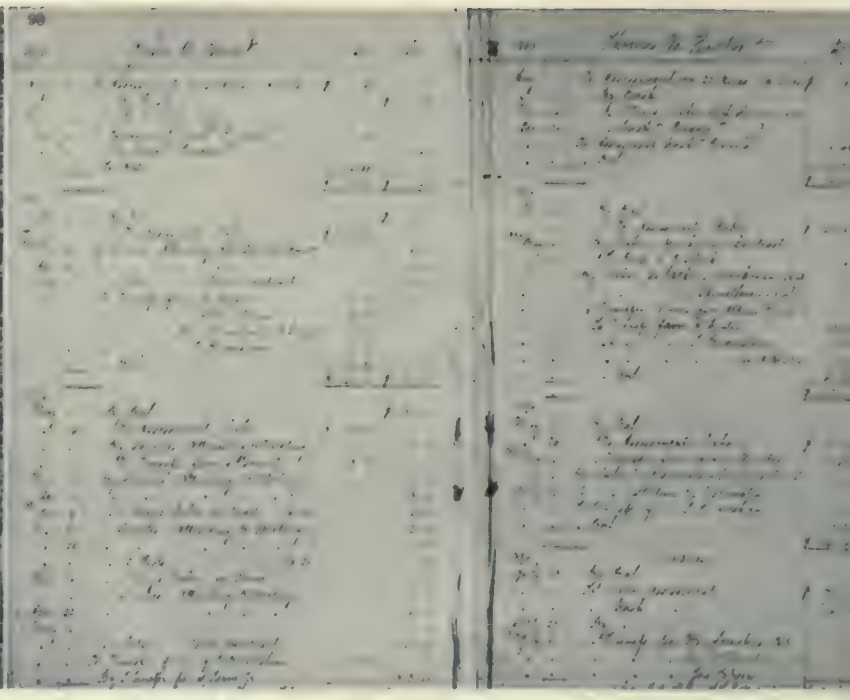
Dr. John A. Widtsoe.

Soon, in good earnest, irrigation canals were projected and dug. There were few surveyors. Often the course of a canal was planned by sighting over a glass filled with water. Occasionally the results were disastrous as when the end of the canal was higher than the beginning.

There were no contractors to make bids for the work. The people, with limited tools, had to build the canals and the necessary structures themselves. That meant cooperation. Each man dug his own share of the canal, enough to irrigate the land assigned to him. Altogether, when the work was finished they looked with gratitude upon the desert-conquering, food-producing canals which they themselves had built. The common enterprise, successfully completed, made them as one. That was a step forward in the higher civilization.

After 18 years, about 1865, nearly 150,000 acres were under irrigation, 1,000 miles of canals had been dug, and nearly 65,000

Logan-Hyde Park-Smithfield Canal, carved out of solid limerock in 1861 and 1862, is still delivering water.



Balance sheet of Hurricane Canal Co., showing how labor at $2 a day was credited against assessments in return for water shares.

persons were living in fair comfort on the reclaimed land.

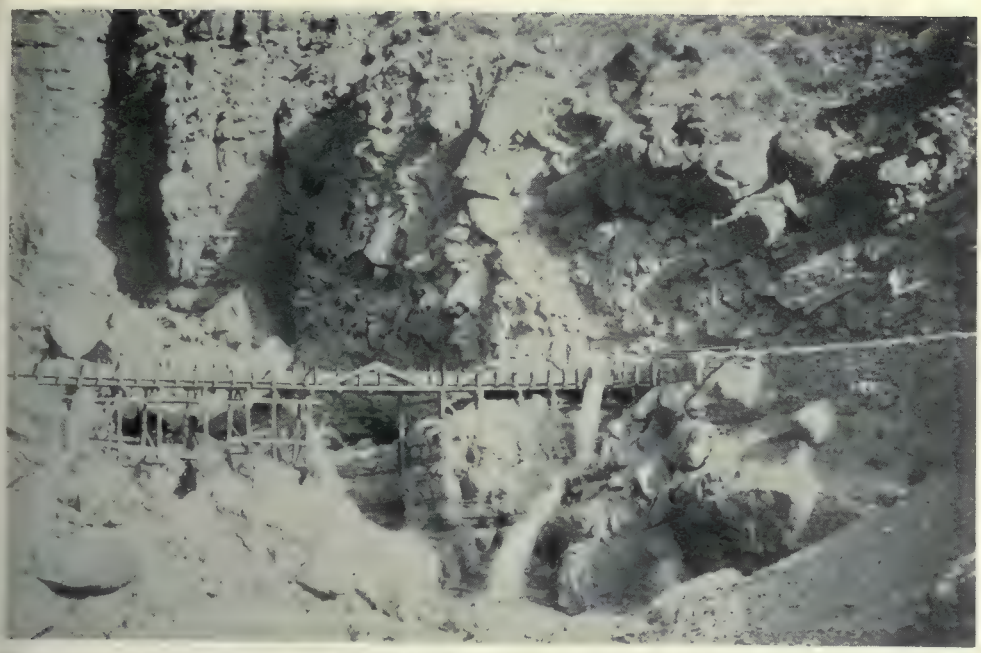
However, whenever water was diverted from the natural course of a stream, it was in violation of an ancient, well established common law. For centuries society had decreed that no person had the right to disturb the natural flow of a stream. That was the time-honored and respected law of riparian rights. Obedience to it would make irrigation practically impossible. The law of self-preservation is above all other laws. The pioneers, therefore, promptly abrogated the older law and set up the law of beneficial use instead. The waters of a stream belong to those who by legal means of appropriation divert or otherwise make economically beneficial use of them. This has become the legal basis upon which the reclamation of the arid and semiarid region of the United States has proceeded. Without this basic doctrine, there would have been no irrigation development.

Many farmers owned one canal and the water flowing through it. That raised a host of problems. How much water should be allotted to each acre of productive land? This made necessary a lawful distribution of the canal water among many users. This in turn required water masters, supervisors, or ditch riders. In the very nature of irrigation, every farmer fears a water shortage, and becomes an incipient water hog. Human problems followed the canal.

Then, too, questions arose when there were transfers of property. Did the water right go with the land, or was it a type of property, independent of use on certain lands? Whose duty was it to clean the canal? The problems involved in what is now termed "operation and maintenance" found their way into the laws of the terri-

Salt Lake City's Eagle Gate, 1861—note irrigation water lower left.

Present day view of same spot. Jordan and Salt Lake Canal now flows beneath street.



This wooden trestle, flume, and high rock masonry carry Hurricane Canal water across a deep wash.

tory. Before long a code of legal regulations was established, which formed the sound foundation of our present irrigation practices.

The pioneer irrigators paved the way to irrigation success by their cooperative labors, by shattering the law of riparian rights, and by setting up rules and regulations by which civilized communities could live happily under the ditch. In view of recent studies, it is remarkable how well, without knowledge of Italian and Spanish irrigation practices, these questions were answered by the pioneers.

It was nearly a quarter of a century (1870) before serious attention was given by other people to the irrigable West. In 1870, the Union Colony of Colorado, an irrigation project on a community scale, was founded under the influence of Horace Greeley. It drew heavily upon the experience of the Utah settlement. Other irrigation colonies followed. Irrigation was moving toward the highway. America was discovering the West. In 1878, John Wesley Powell gave the westward movement impetus by his report on the arid lands. From 1870 to 1880, the population of the Mountain States doubled; from 1880 to 1890 it almost doubled again. It has continued to increase ever since; and always on the basis of irrigated lands. The irrigation story of those years was not always that of success. Uninformed investors, and dishonest exploiters appeared and met failure. But, in the main there was constant progress.

Hurricane Canal emerging from one of nine tunnels in its 8-mile course.

Hurricane Bench, 1904, before irrigation.

Hurricane Bench as transformed by irrigation from Hurricane Canal.

In the decade 1890 to 1900, when the agricultural experiment stations got under way, there appeared the beginnings of the experimental study of the farmer's practice of irrigation. Irrigation engineers were on most of the western station staffs. The use of water had followed practical experience which might be misleading when factors of soil, crops, and climate were not considered. The United States Department of Agriculture set up an office of irrigation investigators to help the irrigation farmer. In 1901 the Utah station began an elaborate investigation of the relationships among water, crops, and soils. Out of these experimental efforts has come much new knowledge, laws of nature, of benefit to the farmer under the ditch. The notable personalities engaged in this work have made American history.

Then the Government of the United States undertook at last to champion the cause of irrigation. The Newlands Congressional Act of 1902 provided that irrigation works, beyond the easy reach of the ordinary cooperative methods, might be constructed with Federal funds, the investment to be repaid gradually, the first specified period being 10 years, by the farmers. As a result of this and supplementary acts, 54 projects have now been built, yielding water to more than 4,000,000 acres of land, and serving nearly 100,000 families. Under the direction of the Bureau of Reclamation, an empire, uniting the two seacoasts of America, has been built. Some of the works are wonders of the world, such as the pioneers did not dare to dream about.

At the beginning, this Government venture was almost wholly in the hands of engineers, who were instructed to look for suitable combinations of available water and land. Little or no attention was given to soil nature or quality. When the projects were completed, they were opened to all citizens, irrespective of fitness to farm under the ditch or anywhere else. As a result, minor financial and human disasters added to the store of experience, which led to a fuller consideration of the many factors that operate to make a successful irrigation enterprise.

It was early evident that if farmers beginning with raw land should repay construction costs in 10 years, only a few projects could be built. The period of repayment was, therefore, extended to 20 and then to 40 years. Nowadays people are thinking of a period of repayment, proportioned to the cost of construction, that may entail two generations of a family, and approximate a modest annual tax. Moreover, power, which has come to be an important element in the Nation's economic life, is now being given careful attention on many of the Government projects. Power revenues will aid greatly in repaying the Government for its investment in irrigation works.

We have learned much irrigation lore since the men of 1847 resolved to tame the desert, and diverted water through their tiny ditch from City Creek to plant a bushel of potatoes. We know now that irrigation and colonization go hand in hand; that the project must be adequate to enable the farmer to make repayment; that it is best to select settlers suitable for life under the ditch; to give the farmers help, chiefly by demanding from them no more than they can reasonably do; and to organize the people under the ditch as communities having, as a common cause of interest, the structures that supply them with water. And we have learned to bring other, perhaps lesser, forces into operation.

The progress of irrigation in a hundred years has been beyond our wildest dreams.

Now we look to the future. The engineer must harness the great quantities of unused water; he must also eliminate from canals and ditches the losses by seepage that destroy areas of fertile lands. The farmer must learn the law under which water enables plants to grow, and to reduce the waste that comes from superfluous irrigation. He must also plant suitable, intensive crops, the income from which will meet the overhead costs of irrigation structures, and labor in applying water on the farm.

Our irrigation problems are today as important as those that faced the pioneers 100 years ago—but we have more knowledge and techniques with which to solve them.

Dr. Widtsoe points to the Jordan and Salt Lake Canal, one of the earliest in Utah.

ABOUT THE AUTHOR

John A. Widtsoe, Ph. D., LL. D., is a member of the Council of the Twelve, Church of Jesus Christ of Latter Day Saints, and past president, Utah State Agricultural College, and the University of Utah. He performed a valuable service for the Bureau of Reclamation as Secretary and Vice-chairman of the 1923 Fact Finding Commission, which investigated the operations of the Reclamation Bureau (then the Reclamation Service) from the beginning, and reported the studies on April 10, 1924, in the document, Federal Reclamation by Irrigation. On the basis of this publication, the Congress passed, on December 5, 1924, an act designed to help settlers on Federal irrigation projects make repayments and to make future Federal irrigation development more secure. This act is commonly known as the Fact Finders' Act of 1924. He was appointed to this commission by Secretary Hubert Work of the United States Department of the Interior. Dr. Widtsoe is also the author of Dry Farming, The Principles of Irrigation Practice, Success on Irrigation Projects, and many other documents pertaining to irrigation.

CORRECTION—East should become West

The illustrations of the East and West portals of the Alva B. Adams tunnel, appearing on the center spread of the April issue for the article, "Colorado-Big Thompson Project" were transposed. The photographer for the pictures appearing on page 87 was Arthur Fawcett, Region VI.

Homes For Veterans

Designs for living on a Reclamation farm, plus material and equipment, will add up to attractive and efficient homes for veterans of World War II and their families, who are now settling on Reclamation lands.

by Carl J. Thye

Branch of Operation and Maintenance, Washington, D. C.

Conversion convenient—if moved as is.

VETERANS! How would you like to have one of the homes shown on pages 104 and 105?

It won't be easy, but it is quite possible to build a tailor-made home to fit your needs out of the material and equipment made available to you under the Interior Department Appropriation Act for the fiscal year 1947 (Public Law 478, 79th Cong.). This act provides that certain properties such as land, buildings, equipment, and furnishings transferred from the War Assets Administration to the Bureau of Reclamation, be made available first to veterans who have been awarded farm units on public land opened for entry during 1946 and 1947.

You can live in these buildings temporarily, select your favorite architectural design, and although the result will depend primarily upon you and your own self-sufficiency, the Bureau of Reclamation will help you over the tougher hurdles.

Under the Bureau's plans, each settler will be given, free of charge, either two barrack-type buildings, or one barrack and the equivalent in small farm buildings, such as chicken houses, hog houses and other miscellaneous buildings, which can be moved bodily or in sections to the new farms—or entirely dismantled for moving. (See *The Bureau Reclaims Its Own* in the April ERA for the story behind these barracks.)

You will be wise if you have the buildings moved in sections suitable for the size house you need. To help you decide this vital question, the Bureau of Reclamation has prepared sketch plans showing one-, two-, and three-bedroom houses which can be constructed from these barrack buildings. Also, farm homestead lay-out sketch-plans have been prepared, and all of these will be made available to successful entrymen to help them make the most of the buildings presented to them. The sketches included with this article are typical of the suggested plans. You don't have to be an expert in designing and constructing buildings to follow these plans.

Particular attention has been given to the planning of the farm home so that it may be attractive and convenient to the business of farming. The home becomes the office of the farm business. In a farm home, usually the kitchen is considered the most important room in the house. It is literally the headquarters of the homemaker. Here all the meals are prepared and served, home-grown foods are prepared and canned, young children play here during the day, and in the evening it becomes a study hall for the older children.

In the winter, the cook stove furnishes much of the heat for the house and for heating water. An auxiliary work area to the kitchen is very important. This may be a part of the basement. Here wet laundry may be hung to dry in cold weather, farm products canned, milk separated, meats cut up, lard rendered.

Space for heating plant, fuel room, work shop, and a place to leave chore clothes before entering the house should be provided in this space. A basement should be a wish of all settlers as it becomes a most important part of the home, and can be constructed at minimum cost. It is important that the walls be made moisture proof, with enough window area to insure abundant light and ventilation. Stairs should lead to the yard as well as to the main floor of the house.

The living room is the center of leisure-time activity. Here the family reads, listens to the radio, entertains friends. House plants can be grown in the sunny windows.

The bedroom should be large enough to accommodate twin beds, or one double bed, and a child's crib. They should be on the side of the house to secure the best ventilation, and be as near the bathroom as possible.

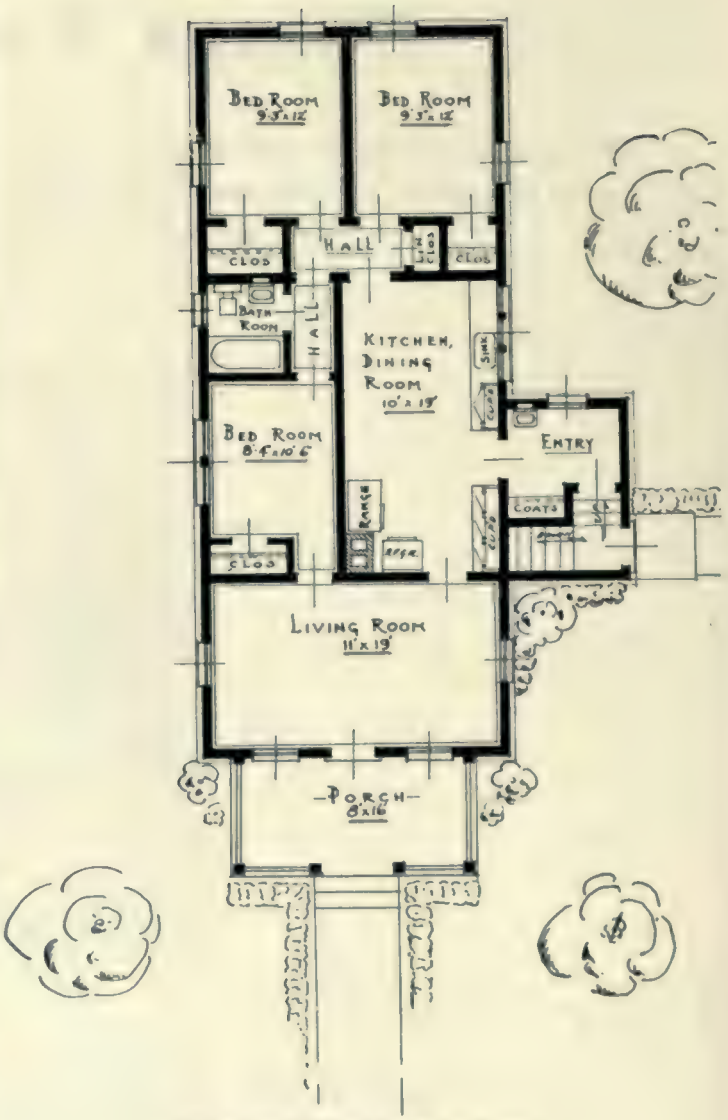
The mode of life of new settlers will be characterized by a large degree of self-sufficiency; this especially is true in new land settlement areas. It is quite possible that most of the settlers will be young people and in many cases the brides may be city

(*Continued on page 105*)

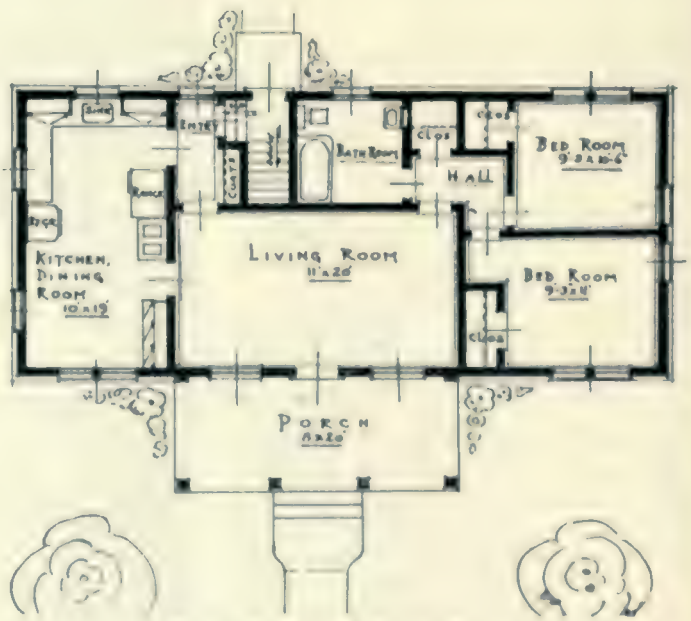
Build your own home from barracks like these.

Front elevation—three-bedroom house.

Front elevation—two-bedroom house.

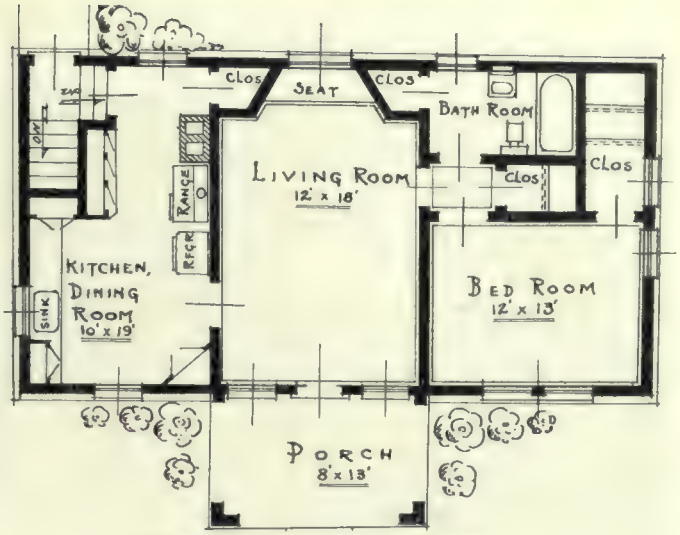


Floor plan—three-bedroom house.



Floor plan—two-bedroom house.

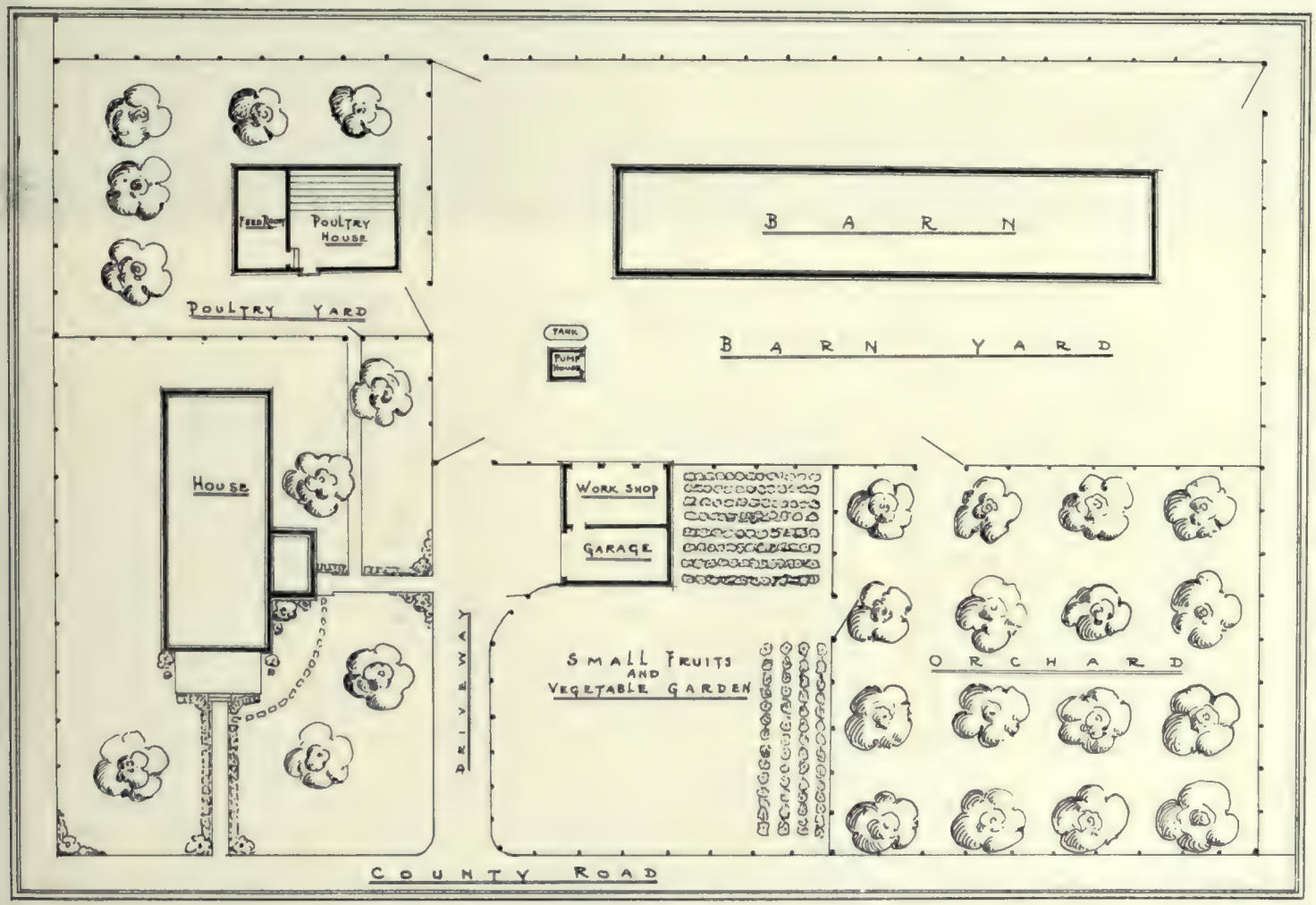
Front elevation—one-bedroom house.



Floor plan—one-bedroom house.

girls, coming to farms for the first time. It is essential that their new homes be made attractive so that they will learn to adopt the farm mode of living, and be happy to stay on these homesteads and help build a new community. It will be important for settlers to cooperate with their neighbors in order to make the maximum use of their labor resources. They will have to purchase materials and equipment to complete their farm structures, but the cost of farmstead buildings with certain accommodations can be held to a minimum, if the materials at hand are carefully selected and used in the proper place. Appreciable savings in cost of these materials and equipment can be realized through volume cooperative purchasing.

You are not the first entrymen on Reclamation farms, and there is plenty of help and advice available. Now, what will it be—blue or green shutters for that future home? The Bureau will not advise on that point. Leave it up to the Missus.



Homestead layout plan.

DATE SPREADER

A "gadgeteer" at work.

"Air conditioned" dates.

The Reagan's, of Phoenix, Ariz., invent a new gadget and reduce spoilage and harvesting costs in their date gardens.

by Ralph O. Baird,

Reclamation Economist, Phoenix Office of Project Planning, Region III, Phoenix, Ariz.

NECESSITY has mothered another invention. This time the event occurred at the M. F. Reagan residence at Forty-Eighth Street and East McDowell Road in Phoenix, Ariz., where Mr. Reagan and his son, Carl, have developed a gadget to reduce spoilage in their date garden.

Humidity, the bane of all date growers, has been causing rather severe losses in Phoenix gardens the past few years, and 78-year-old Mr. Reagan decided it was time he did something about it. After trying several models he has perfected a wire spreader which, when inserted in the fruiting frond, opens the bunch and permits the free circulation of air around the ripening dates.

This device consists of a wire ring 9 inches in diameter, on which two wires are attached. The four ends are bent around the ring equal distances apart and extend spoke-like 2 inches beyond the perimeter. The centers of the wires are joined about 10 inches above the ring to form a conical apex.

A hollow sheet metal cone with a handle in its fluted and turned-back base is used to insert the ring in the bunch of dates. The branches of the fruiting frond are then evenly distributed between the four spokes, and the entire gadget (it is still nameless) is kept in place by soft wire fasteners which are twisted around the stem of the fruiting frond.

Mr. Reagan used the gadget on all of his trees last year and he claims to have suffered almost no losses from fermentation spoilage, although the heavy rains that fell last September caused extensive damage to the crops of most Phoenix date gardens.

The open bunches also facilitate harvesting, and his pickers unanimously declared they could harvest almost twice as fast in Mr. Reagan's garden than they could where the Reagan spreaders were not used.

Neighboring date gardeners have encouraged Mr. Reagan to manufacture the appliance. He has made patent application and is now equipping his home workshop to turn out a quantity of the spreaders for other date growers. He hopes to have an ample supply of these spreaders available for sale in the very near future.

The Reagans are what might be called "gadgeteers." These activities provide an ample return for the rather extensive investments in metal and wood lathes, bench saw, joiner, jig-saw, drill press, and the many hand tools not found on the ordinary small ranch. They have made much of the mechanical equipment needed for their date garden and orange grove. Among the things constructed are an air compressor and its spraying and weed burning attachments.

NEW HORIZONS IN THE COLUMBIA RIVER BASIN

BY HU BLONK

Region I, Boise, Idaho

IN 1792 CAPT. ROBERT GRAY, standing on the rail of his ship off the coast now known as the Pacific, saw the mouth of a mighty river. Not finding it on such meagre maps as he possessed, he named it after his sturdy craft, the Columbia.

Some 12 years later, in 1804, Meriwether Lewis and William Clark, who had set out from St. Louis to chart a trail to the area now called the Pacific Northwest, looked for the first time upon the largest and most impressive stream of their entire journey. They knew it must be the Columbia. The end of the long trek and success was at hand.

In the more than 100 years since Captain Gray and Lewis and Clark set eyes on the giant river hundreds of thousands of other people—trappers and miners, missionaries and settlers, farmers and just plain tourists, have viewed the Columbia, each with a different emotion.

This spring, the Department of the Interior reported that it, too, had been watching the Columbia. What it saw and how it was inspired was reported to the public for the first time a few weeks ago in a voluminous, 600-page document. It was the most exciting bit of reading, from an economic standpoint, that the Northwest and the Nation had had for some time.

In simple terms, the report states that the Columbia, one of the biggest clear-water streams on the face of the earth, which had spent very little of its boundless energy in useful pursuits, should be put to work. And at least a million people would benefit.

The document, technically called Project Planning Report No. 1–5.0–1, provides for the first time a comprehensive plan for the development of the land and water resources of the Nation's second largest river and all of its tributaries. It outlines vast potentialities in expansion of irrigation and hydroelectric power production, and describes benefits to be gained in navigation improvement, flood control, recreation, fish and wildlife conservation, and pollution abatement.

Prepared by the Bureau of Reclamation in cooperation with local, State, and other Federal agencies, the plan would double the existing irrigated area of the basin, and bring it new and enlarged communities with numerous opportunities for additional businesses, improved highways, greater investments in rural and business property, enlarged tax bases, and many other benefits that result from the transformation of sagebrush into fertile farm areas.

An extensive hydroelectric power development is described, which would increase the present installations of the basin by about five times. The Columbia, constituting the greatest concentration of potential hydroelectric power in the civilized world, would be made to drive 63 new power plants, to provide great volumes of energy for new industries, to lighten and increase the efficiency of farm work, and, in general, make life easier and more pleasant for people in urban and rural areas.

In detail, the plan calls for bringing under irrigation 3,840,000 acres of new land, now for the most part sun-baked and desolate, and providing supplemental water for 1,520,000 acres of irrigated land on which maximum crop production is not now attainable because of periodic shortages. About 10,600,000 kilowatts of installed power capacity are to be added. Flood

Western irrigation creates market for outside materials.

The plan will mean a lot to these future irrigation farmers.

Power like Idaho Falls City plant is part of the plan. Church of Latter Da Saints in the background.

protection is to be provided for nearly 1,500,000 acres of land, and drainage projects are to be built to improve the utility of more than half a million acres.

The report mentions, too, extending slack water navigation on the connected waterways in the lower basin—to Wenatchee on the Columbia, and to a point several miles upstream from Lewiston, Idaho, on the Snake. The Willamette also would be improved for navigation, and pollution in the stream materially reduced. A hundred and forty-two dams and reservoirs are to be created to control the river and its tributaries for the various purposes. Some of the projects are to be built by the War Department's corps of engineers; most of them by the Bureau of Reclamation.

Fourth in a series of reports on river basin developments, the Columbia resource plan quickly captured the imagination of the people of the Pacific Northwest, who long have looked upon the stream as the region's greatest asset, but who long have watched it flow, to a large extent uselessly, to the sea. Here was a program they could "sink their teeth into." No longer was it

Enroute to Western markets—products from all over.

n Idaho, irrigated acres produce up to 900 bushels of Spanish onions per acre.

Palatable peaches from the Yakima Roza area.

necessary for even the most enthusiastic of them to talk in vague generalities.

But charting the course for the full utilization of the river's riches for the benefit of the area and the Nation as a whole is not the only significant phase of the plan. The report's recommendation as to the ways and means of returning the cost of the Federal expenditure in the potential development, and certain existing projects totaling an estimated $5,939,765,000 at 1946 prices is highly important. It constitutes the key for opening the treasure chest to river resource development on a sound business basis.

Under the plan, every dollar allocated to irrigation and power is to be returned to the Federal Treasury. Even in the unlikely event that price levels as high as those of 1946 prevail throughout the very long construction period contemplated for fulfillment of the program, revenues from irrigation and power production would still exceed the reimbursable costs, totaling an estimated $5,043,222,000. Some 92 percent of these costs is to be repaid from net revenues from the sale of power alone. The remainder, $386,157,000, is to be repaid

by irrigation farmers and domestic water users. The nonreimbursable costs would be those allocated to navigation, flood control, pollution abatement, and fish and wildlife conservation.

Taking a look at the development plan from a businessman's viewpoint, it is as sound as the American dollar. The annual costs are estimated at $291,276,000 and the annual benefits, $385,358,000. Under this ratio of benefits to costs—1.32 to 1.00—the benefits will exceed the costs by $94,082,000 annually. Is that good business, or isn't it? More than half of the monetary benefits would accrue from irrigation developments, nearly two-fifths from power.

The report presents an "all for one and one for all" theory for repayment of the costs incurred in the development of land and water resources in this 220,000-square-mile basin.

The financial plan calls for extending to the basin as a whole those principles of repayment, long recognized by the Congress, which provide for using power revenues to help repay costs of irrigation facilities that are beyond the ability of water users to repay in a specified time.

Many of the irrigation projects in the basin awaiting development have no opportunities for power production. Although needed as much as other projects fortunate in having power features, and capable of creating similar benefits in new homes, new farm and job opportunities, and crop production, many potential developments (and perhaps some existing projects) cannot reasonably be expected by themselves to return all the reimbursable costs within the maximum repayment period specified by law.

In contrast, the potential power developments on the Columbia and Snake Rivers and other tributaries will have repayment capacities in excess of their reimbursable costs. Several of these power projects will have no irrigation development immediately associated with them.

Clearly, revenues from such power developments could not only pay for the costs properly chargeable to power but could contribute to integrated agricultural and industrial development of the region by helping to make economically feasible many irrigation developments which otherwise cannot be constructed.

This can be accomplished under the basin-wide repayment plan. It would entail pooling the net revenues from designated Federal power plants and utilizing these pooled revenues to assist the repayment of worthy irrigation projects anywhere in the basin. Existing rates would not have to be raised nor would reductions be precluded.

The basin-wide repayment plant can be a sound framework for future expansion of the area for the benefit of the regional and national economy. With few irrigation developments remaining in any of the States on the basin which can stand on their own feet financially, including nearly all of those in the downstream States of Oregon and Washington, adoption of the plan is essential if agricultural stagnation in the future is to be avoided.

While the entire resource development program will take decades to accomplish, a start can be made immediately. This is a timely feature of the report. The plan suggests that work on projects under construction be expedited or begun on projects already authorized. These total 47 in number, and consist of projects authorized for construction by the Office of Indian Affairs of the United States Department of the Interior, the War Department, and the Bureau of Reclamation. Secondly, 14 projects are recommended for early authorization or reauthorization. The remaining 177 projects of the 238 listed in the plan would be undertaken later as needed.

Recommended for early authorization or reauthorization are the following:

Idaho.—Payette Unit of the Mountain Home project, 230,000 acres and 165,000 kilowatts of power; Cambridge Bench, 2,360 acres; Hayden Lake Unit of the Rathdrum Prairie project, 1,000 acres; Council, 6,590 acres; Hornet Creek, 1,970 acres, and Mann Creek, 4,300 acres.

Montana.—Bitterroot Valley (without the Woodside Unit) 32,100 acres; Bitterroot Valley, Woodside Unit, 18,600 acres, and Missoula Valley project, 2,100 acres.

Oregon.—Canby, 1,675 acres; Bully Creek Unit of the Vale project, 5,000 acres; and Crooked River project, 18,500 acres.

Washington.—Kennewick Division of the Yakima project, 17,000 acres and 12,000 kilowatts of power.

Wyoming.—Upper Star Valley project, 15,500 acres.

The benefits from the resource development on the Columbia would be spread far and wide. Every section of the country would be affected.

Fifty thousand to seventy thousand new farms are to be created through the irrigation phase of the plan. These would provide, directly and indirectly, permanent jobs for approximately 100,000 wage earners in local enterprises other than farming. In established irrigation communities, two people are employed in the towns or near the developments, for every person on the farms. Thousands of other people throughout the Nation will be employed in providing goods and services for use by the increased population of the basin. One worker will probably be required in other parts of the United States for every two employed in the locality of the projects.

Thus the irrigation development alone will create a total of 250,000 to 350,000 employment opportunities, and the basis of support for a total population of one million persons throughout the country.

Major benefits will also be realized during the construction of the projects. Tens of thousands of jobs will be created both at the construction sites and at widespread points. United States Department of Labor figures show that for every five men employed on the project, eight are required in the production and assembly of hundreds of items which go into the construction of dams, power plants, canals, and other project works.

The key to unlock the riches of the Columbia was fashioned under the direction of the Bureau of Reclamation, but many local, State, and Federal groups participated. All agencies of the Department of the Interior involved in resource development collaborated. These were the Bureau of Mines, Fish and Wildlife Service, Geological Survey, Bureau of Land Management, National Park Service, Office of Indian Affairs, and the Bonneville Power Administration. Important contributions were also made by the Department of Agriculture, Corps of Engineers, and the Federal Power Commission.

The Governors of the States affected by the plan—Washington, Oregon, Idaho, Montana, Wyoming, Nevada, and Utah—now have the report. When they have commented on it, as they are privileged to do under Federal law, the document together with the remarks by the Governors and those of other Federal agencies, will be transmitted to the President and the Congress.

In the vastness of its Western undeveloped river basins, lie the untouched riches that America needs to move forward in the world economy. There, through the irrigation of parched lands, production of hydroelectric power from falling water, and the utilization of other resources, the country's horizons can be peacefully extended.

OUR BACK COVER

THREE-WAY AGRICULTURE

Rich in fertilizer, food, and forage, this scene on the Boise project, Idaho, is typical of the areas irrigated by Bureau of Reclamation facilities. Here wagons are being loaded with chopped hay from the huge stock pile, preparatory to spreading it about the many pastures of the Carl Nicholson sheep camp.

"W-DAY" At Tucumcari

The Noxious Weed Control Committee spearheaded the drive, and the Citizen Army routed the enemy—Bindweed

by D. D. SUGGS

Agricultural Engineering Aide, Tucumcari, N. Mex., Region V

FARMER-SOLDIERS OF THE AMERICAN REVOLUTION may have been instructed properly when told to hold their fire until they could see the whites of the enemies' eyes, but farmers on the Tucumcari, N. Mex., Reclamation project are firing away at the first biological manifestation of a noxious weed. They aren't taking any unnecessary chances of being surrounded and captured by the forces of "General Infestation."

Community cooperation at Tucumcari, nurtured by active participation in many patriotic endeavors during the last war, did not cease with the end of hostilities. It recently guided citizens in the project area to an early victory in an all-out home-front war on weeds.

Weeds were threatening to become a hazard with the delivery of water on the project, where 45,000 acres of raw land are being converted into irrigated farms. The initial unit of the project received its first water in the fall of 1945.

It is generally known that when water is applied to semiarid land, it creates conditions favorable to propagation of weeds as well as crop plants. Successful irrigation farmers know that eradication or control of noxious weeds is a "must" item on every good project.

Citizens of the Tucumcari project area were prompt in mustering combative measures. With complete cooperation of the Bureau and other Government, city, and State agencies, a weed-control program was launched in May of last year, and almost immediately proved its effectiveness.

Project investigation of this "boring from within" problem actually began in 1942. When these early Bureau-community cooperative planners for the war-to-come had completed preliminary plans, they retired from active weed-war duty until the construction program had advanced to the point when water would be available to the first part of the project.

W-day arrived in 1945. A Noxious Weed Control Committee was formed to study further details of the impending battle, and recommend and initiate eradication and control measures before the advent of irrigation could increase current infestation.

By spring, 1946, the strategy had been defined, the maneuvers planned. Reconnaissance reports singled out bindweed as the most dangerous "dictatorship" threatening the project area. It had begun infiltration tactics, and thus became the initial objective. Tucumcari city fathers made first contact with the enemy in and adjacent to the community. Bindweeds were sprayed at city expense with a one-tenth percent solution of the chemical 2,4–D (1 part chemical to 1,000 parts of water—also termed 1,000 parts per million). The thorough coverage of urban-infested areas is believed unique in the history of weed eradication campaigns.

The weed war was conducted in the city of Tucumcari and its adjacent area, because of the well-known fact that weed enemies building up a stronghold in any sector adjacent to peaceful weed-free agricultural land would, as well as creating havoc to gardens and lawns, soon be sending their forces out to conquer new territory. The city campaign contributed greatly to the ultimate success of the project venture.

City participation in the drive followed a conference of members of the Noxious Weed Control Committee, headed by Quay County Agent C. A. Grimes, and city and county officials including Mayor Virgil Montgomery, City Manager John Bender, Chamber of Commerce Secretary E. E. Rivers, and County Commissioner J. L. Jordon. Many businessmen and farmers also attended the initial parley.

A survey of bindweed in the city and project area had been completed under direction of W. H. Mercer, agricultural aide (see "Weeds—and Their Worthy Opponent," December 1946 ERA.—Ed.) and L. C. Brown, agricultural adviser for the Bureau of Reclamation.

It is an old military axiom that no war can be successful without complete support of the home folk. The weed-war's board of strategy did not overlook this phase of its campaign. To arouse the community generally to the peril and to acquaint the prospective servicemen and women with methods for eradicating and controlling weeds, the strategists arranged for a series of public demonstrations. The Bureau prepared a series of newspaper articles about weeds—the additional trouble and cost they create on irrigation projects. These articles, accompanied by photographs, were published

in The Tucumcari Daily News and The Tucumcari American.

Otto Dillon, vocational agriculture instructor in the Tucumcari High School, went on the radio with announcements about the bindweed eradication demonstrations planned for the community.

Tucumcari Service Clubs sponsored showings of the Bureau's sound and color motion picture, Fighting Weeds. Following a series of exhibitions in the city, the film was taken into rural areas. It was shown six times for various classes at the high school and at a banquet in honor of Reclamation Commissioner Michael W. Straus. Weed-war plans were explained to Commissioner Straus and Regional Director Wesley R. Nelson. These officials joined in the campaign, speaking publicly about the harmful effects of weeds on irrigation projects, and commending the people in the area for their vigorous spirit in planning for the actual war.

The month of May was a merry one for weed killers. It was the time for demonstrations, and those in town and country were to be followed by day-to-day killing forays throughout the area.

The demonstrations attracted businessmen, farmers, farm women, farm boys and girls. The Tucumcari Garden Club sent a delegation to join forces in the front line attack. Members of the Future Farmers of America and 4–H Clubs were present and assisted in the drive.

During the demonstrations in May, Mercer, the Bureau's weed specialist, continued his talks to service clubs, luncheon clubs, and similar organizations in the community. He stressed the difficulties of farming in a weed-infested irrigation project, and rallied additional forces to combat the hazard before it could become more dangerous. Mercer also spoke at each demonstration. He answered questions about mixing the spray, quantities used, time required for killing, the occasional need for respraying, the effect of spray on farm crops, grasses and shrubs.

The community was aroused. Mrs. U. S. Devor, a member of a committee responsible for the beautification of the Tucumcari cemetery, and wife of a director of the conservancy district, reported a bindweed infestation in the cemetery. Within a few hours a spraying crew made an attack, and had the enemy under control in that sector.

K. I. Langley, local seed dealer, contributed the 70 percent compound of 2, 4–D in powder form for use in the demonstrations. Farm boys ran errands, and helped assemble the spray equipment and other materials needed for the campaign. Men and women in town and in the rural areas responded to calls for help in many divisions of the campaign. The undertaking became glamorized and had an atmosphere somewhat like that of an old-fashioned, Ozark Mountain husking bee or corn-in-the-tassel hoe-down. It was a serious job, but not without fun.

The demonstrations throughout the month of May and subsequent individual killing campaigns were not accomplished without difficulties. County Agent Grimes furnished his spray equipment, but many of the fittings needed repair parts which World War II had made scarce. Grimes and Bureau employees, FFA and 4–H Club boys worked in the Bureau' shop, making necessary parts. Spray nozzles were lent by the House Cooperative of House, N. Mex.

Home owners, although good soldiers, and eager to have weeds killed in their yards, were fearful of the damage that might be inflicted upon their flowers, trees, and shrubs. Rather than desert the cause, they volunteered to use hand sprays containing the weed-killing element, and personally protect their homes. One amateur gardener was made happy when told he could do his own spraying and guard against damage to his prized gooseberry crop.

Five weeks following the first spraying demonstrations a survey revealed an approximate 90 percent kill of the enemy. The best kills were found in areas sprayed soon after a shower, and in locations having sufficient moisture to promote vigorous growth. The least kills were in areas where the soil was extremely dry and hard.

The Tucumcari project weed-killing demonstrations and subsequent killing expeditions on project farms were but the beginning of a war that will be revived any time weeds imperil the area. The bindweeds are disarmed. Other weeds will be killed as they pop up in dangerous numbers. The people of Tucumcari and the project area are going to make the weeds keep the peace.

Plans for future weed control were made which were included a pure seed show held this past winter in Tucumcari. The show included a weed and weed-seed exhibit. Examination of crop seed for foreign elements, especially infiltrating weeds, and pure seed judging were demonstrated. Farmers were urged to plant only weed-free seed.

Future Farmers of America and 4–H Club boys had a big part in the show. They were taught how to identify weed seed prior to planting their project crops this spring. The Garden Club cooperated in plans for the show and the members will strive to keep weeds out of their gardens.

One Garden Club member, exemplifying the spirit of the whole community, said she is willing to sacrifice her flower bed for an entire year if necessary to help keep the weed-enemy from the reclamation project. The Tucumcari reclaration project's First Rout Army has made good!

County Agent Grimes leads the battle.

Citizens join the First Route Army.

The Fortune Tellers

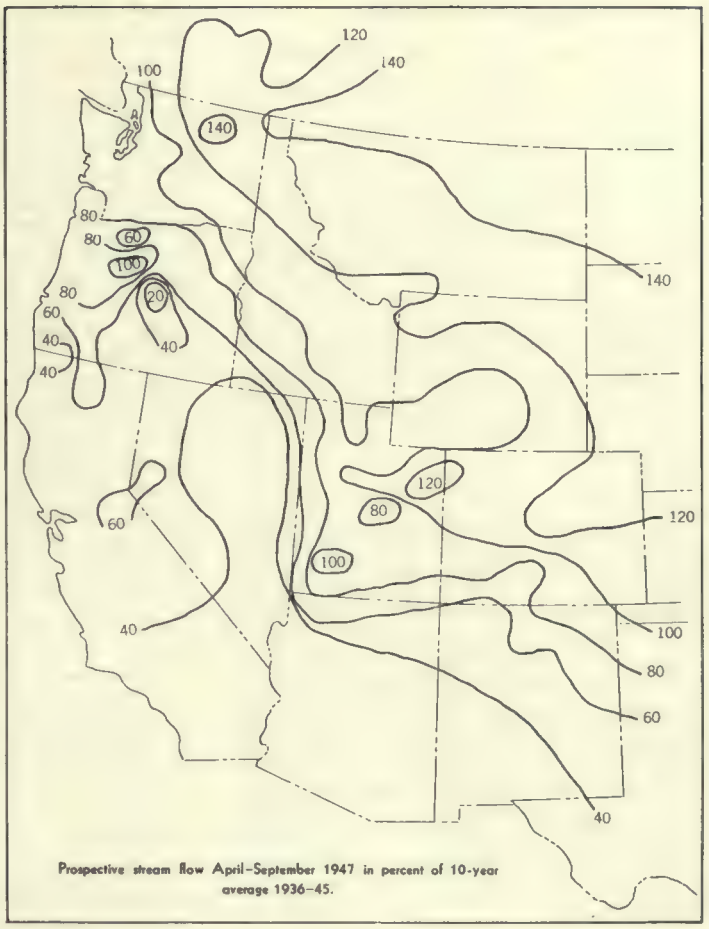
West-Wide Forecasts of 1947 Water Supplies, Based on Work of the Western Snow Surveys

By Paul A. Ewing

Senior Irrigation Economist, Soil Conservation Service,

and R. A. Work,

Senior Irrigation Engineer, Soil Conservation Service



Prospective stream flow April–September 1947 in percent of 10-year average 1936–45.

WATER'S YOUR FORTUNE, *son—just in case you didn't know—and people who prophesy about western water supplies are therefore fortune-tellers. But water-supply forecasting is serious business, not to be done merely by gazing into the crystal ball. In fact, it's out of the realm of guesswork, and farmers can now be told pretty closely what water they will have for irrigation, well in advance of its actual need.*

To forecast summer water supplies a close knowledge of winter snow storage is necessary. How much snow is held in our high mountain fastnesses? How much water will it yield when melting? When will it melt? As western water supplies become scarcer and scarcer it is more and more important that these things be ascertained in order that the fullest possible use may be made of what water we have.

UNDER THE TERMS of a recent agreement, the Bureau of Reclamation is cooperating to this end with the Division of Irrigation and Water Conservation, Soil Conservation Service. This agreement provides for establishing many new snow courses. More frequent measurements also will be made on some important courses now used in forecasting water supplies for project lands. The Soil Conservation Service has, for a dozen years, been the Federal coordinating agency in snow surveys. Previous to 1935 a multitude of agencies—Federal, State, and local—made snow surveys, but no consistent effort was made to systematize their methods and procedure or to broaden their objectives. Limited local needs were well served, perhaps, but wide coordination of results was not attempted.

The Division of Irrigation and Water Conservation undertook two principal jobs: to fill in the gaps, and to standardize equipment. In carrying out the first objective it conducts many snow surveys, adding them to the many more that are still made by the other pioneering organizations. The results of the latter surveys it collects, analyzes, and publishes, together with its own. All surveys are now carried out pretty much along identical lines and with standardized apparatus. The cooperating agencies include Soil Conservation Service field men, Forest Service and National Park Service rangers, irrigation district managers, Geological Survey stream gagers, power company patrolmen, Fish and Wildlife hunters, and Indian Service and Bureau of Reclamation employees. The snow surveys of the government of British Columbia are closely coordinated with the Columbia River work. Last winter nearly 2,300 separate snow surveys were made at 925 mountain locations by a force of almost 1,000 men from 170 cooperating agencies. Notwithstanding all this multitude of effort a high degree of harmonization has been attained; precise comparisons from survey to survey and from year to year are made possible, and the snow-water forecasts based on the measurements are increasingly accurate.

How the Surveys Are Made

The surveys comprise periodic visits to the carefully located snow courses, each of which is marked with a number of permanent stations (steel poles topped with official snow-course signs); and every set of measurements is taken each time at the exact spot where the preceding ones were made. The Federal sampler now in universal use consists of 30-inch lightweight metal tubes which, when screwed together, may be pushed down through the deepest snow. Thus a complete column, or sample, can be obtained by withdrawing the tube. The snow-filled tube is immediately weighed on a hand scale so calibrated as to give a reading of the inches of water in the measured snow. These weighings form the basis of forecasts of spring and summer run-off, which are issued in great detail a few days after the surveys, so that water-users are afforded a comprehensive outlook for all the principal watersheds and drainage basins throughout the West.

The work of visiting some of the more isolated snow courses, especially when climatic conditions may be severe, is often arduous in the extreme, involving long trips by skis or snowshoes. Recently the improvement of snow-transit machines has removed some of the hazards of this work, and further easing is expected as the use of these conveyances is extended. At present, however, many surveyors travel in pairs, and are protected against undue exposure by 185 shelter cabins, constructed or stocked by the Division of Irrigation and its cooperators, and scattered along some 20,000 miles of winter ski trails. Enough food and other emergency supplies are in one of these cabins to supply the needs of a snow survey party for several days.

The first reports of the surveys are those of January 1, and the last those of May 1, that being the latest date when the maximum accumulation of snow may be measured. April results, however, are usually not greatly modified by those obtained in May. In some of the States the final spring forecasts for the different water basins are made at local meetings participated in by anybody having pertinent information on the situation. For the whole Columbia Basin, the Columbia Basin Water Forecast Committee, composed of representatives of all States in that basin (and British Columbia), meets in Portland after the middle of April and draws up the general Columbia Basin forecast. A similar group representing the Colorado River Basin meets about the same time in Los Angeles.

Prospects for 1947

The following paragraphs summarize the water-supply prospects, State by State, as indicated by the April snow surveys. In general, the picture is similar to that shown a year ago, though perhaps less favorable. Severe shortages appear in prospect for the Southwest, including parts of California and Nevada, but with a progressive improvement from south to north. Rio Grande run-off will be deficient, as will that of southernmost tributaries of Colorado River. Columbia Basin will fare pretty well as will also the slopes east of the Rocky Mountains. The two charts accompanying this article further summarzie results of the April surveys.

Arizona

An acute shortage of water is imminent throughout the major irrigated areas. The winter snow-water crop was very short, record lows being recorded for most snow-survey courses. This shortage, coupled with general below-normal precipitation, will produce abnormally low run-off during the irrigation season. Reservoir storage is near an all-time low for April 1, being only 15 percent of total capacity (the 1936–45 average was 40 percent of capacity). Storage in Lake Mead (behind Boulder Dam) has declined to 59 percent of capacity from the 1936–45 average of 72 percent.

California

A general shortage is in prospect, the full natural April 1 to July 31 stream flow of snow-fed mountain streams being forecast by the California Cooperative Snow surveys, in comparison with the 1936–45 average, means from 28 percent for Kern River at Bakersfield to 68 percent for Sacramento River at Shasta Dam. Other principal Sierra streams show the following prospective run-offs: Kaweah River at Three Rivers, 41 percent; Kings at Piedra, 50; San Joaquin at Friant, 54; Merced at Exchequer, 51; Tuolumne at La Grange, 55; Stanislaus at Melones Dam, 60; Mokelumne at Mokelumne Hill, 61; American at Fairoaks, 51; Yuba at Smartsville, 54; Feather at Oroville, 53. The over-all picture may thus be said to promise about a 50 percent year. However, 24 reservoirs having a total capacity of 2,869,000 acre-feet of water, are holding 1,742,000 acre-feet, or 61 percent of capacity. The average storage in the 1936–45 period was slightly less than this amount, or 60 percent of total capacity. Three major reservoirs not included in the 24 were put in operation by 1944. They are: Narrows, capacity 45,000 acre-feet; Friant, 436,500, and Shasta, 3,714,000. On April 1 the total storage in the 27 reservoirs including these three was 71 percent of total capacity.

Colorado

Prospects vary widely, streams east of the Continental Divide promising run-off generally in excess of the 1936–45 average, while Rio Grande Basin streams will be in generally low supply (from 65 to 90 percent of average). Southern Colorado Basin streams will flow substantially below normal but those in the northern part of the basin will exceed the average. Forty-seven reservoirs have filled to 41 percent of total capacity, as compared with an average April 1 filling of 32 percent.

Idaho

The snow pack is progressively lighter from north to south, so that run-off substantially in excess of the 10-year average is in prospect for northern streams but some southern areas will have subnormal supplies. Kootenai and Clark Fork will experience heavy run-off, with some likelihood of floods. Mid-Idaho stream discharges will be about normal, with no severe floods in prospect and a water supply generally adequate for irrigation. In extreme southern and western areas the outlook is for irrigation shortages ranging from slight to severe, depending on weather conditions during the planting and growing seasons. Water stored in nine major reservoirs, including Jackson Lake, is 87 percent of capacity as compared with the 10-year average of 77 percent.

Montana

Run-off prospects are 15 to 20 percent better than a year ago, with reservoir storage also higher. Precipitation is above average, recent heavy storms having reversed the previously-developing dry trend. Stream flow is about normal for mountain streams, while severe floods have occurred in the eastern part of the State. Soil moisture conditions are good. Seventeen reservoirs west of the Continental Divide are 39 percent full, or slightly better than on April 1, 1946; 23 in Missouri drainage are at 74 percent of capacity (64 percent last year), and Fort Peck reservoir is 79 percent full (68 percent a year ago).

Nevada

The summer run-off available for irrigation will be short, with the general average ranging from 40 to 50 percent of the 1936–45 average. Soil moisture and ground-water conditions are fair, but the snow-water storage on the mountains is poor. Reservoir storage is very good, and total storage may reach 90 to 95 percent of reservoir capacity, thus helping to alleviate the shortage of natural stream flow.

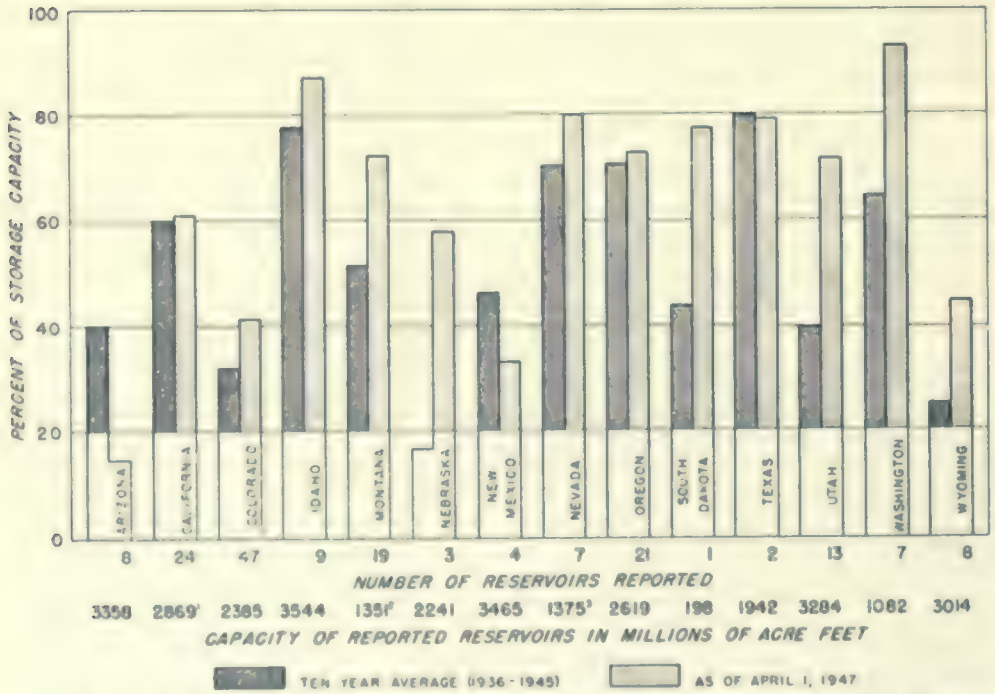
New Mexico

Rio Grande drainage promises run-off substantially below the 1936–45 average, only Taos River showing a discharge in excess (125 percent) of normal. Other forecasts for the basin, in percent of normal are: Chama, 65; Embudo, 52. The main river, at Otowi Bridge, will flow 76 percent of normal. Discharge of Pecos River will be less than half (48 percent) of the 10-year average, while that of Canadian River, while better than Pecos, will be only 75 percent

(*Continued on page 116*)

PERCENT OF RESERVOIR STORAGE CAPACITY

TEN YEAR AVERAGE (1936-1945) COMPARED WITH STORAGE CAPACITY AS OF APRIL 1, 1947



Not all reservoirs in all States are reported, but enough are reported to give a reliable index of each State's storage supply. Most State averages for reported reservoirs are for full 10-year periods, but in a few cases reservoirs having shorter records are included.

[1] Does not include Narrows (Yuba River), Friant, or Shasta Reservoirs. April 1 storage in these three reservoirs combined is 3,287,000 acre-feet, which is 78 percent of their capacity.

[2] Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet). April 1 storage 14,980,000 acre-feet.

[3] Does not include Lake Mead (capacity 31,140,000 acre-feet). April 1 storage approximates 18,372,000 acre-feet.

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	Mar. 31, 1946	Mar. 31, 1947
Region 1	Baker	Thief Valley	17,400	17,700	17,400
	Bitterroot	Lake Coma	34,700	9,400	20,400
	Boise	Anderson Ranch	464,200	33,025	97,800
		Arrowrock	286,600	262,100	247,800
		Deadwood	161,900	108,140	116,900
		Deer Flat	169,000	153,760	158,200
	Burnt River	Unity	24,600	13,500	24,000
	Columbia Basin	F. D. Roosevelt	5,220,000	5,110,000	5,108,000
	Deschutes	Crane Prairie	50,000	39,700	41,200
		Wickiup	187,000	70,600	97,900
	Minidoka	American Falls	1,700,000	1,370,500	1,618,400
		Jackson Lake	847,000	581,500	577,900
		Lake Walcott	95,200	69,300	69,000
		Grassy Lake	15,200	14,300	12,800
		Island Park	127,300	128,700	132,400
	Okanogan	Conconnully	13,000	5,000	6,100
		Salmon Lake	10,500	9,500	9,400
	Owyhee	Owyhee	715,000	681,600	593,600
	Umatilla	Cold Springs	50,000	48,900	50,000
		McKay	73,800	62,100	66,300
	Vale	Agency Valley	60,000	54,600	51,900
		Warm Springs	170,000	141,100	136,500
	Yakima	Bumping Lake	33,800	3,200	34,400
		Clear Creek	5,300	5,300	5,300
		Cle Elum	435,700	180,700	413,000
		Kachess	239,000	201,300	220,800
		Keechelus	153,000	94,100	154,600
		Tieton	197,000	118,400	171,300
Region 2	Central Valley	Millerton Lake	503,100	276,700	337,600
		Shasta	4,389,100	3,214,000	2,758,100
	Klamath	Clear Lake	437,500	295,200	226,700
		Gerber	94,300	51,600	42,500
		Upper Klamath Lake	524,800	334,400	345,100
	Orland	East Park	47,900	50,900	31,700
		Stony Gorge	50,000	51,000	39,800
Region 3	Boulder	Lake Mead	27,935,000	17,774,000	16,383,000
	Parker	Havasu	688,000	644,800	649,000
	Salt River	Bartlett	179,500	1,800	10,300
		Horse Mesa	245,100	224,500	234,200
		Horseshoe	67,000	10,020	13,700
		Mormon Flat	57,850	38,700	40,600
		Roosevelt	1,398,400	362,200	80,600
		Stewart Mountain	69,800	19,400	52,200
Region 4	Fruit Growers	Fruit Growers	4,500	3,655	2,100
	Humbolt	Rye Patch	179,000	187,700	185,900
	Hyrum	Hyrum	15,300	15,500	11,900
	Moon Lake	Moon Lake	35,800	17,860	9,000
	Newlands	Lahontan	273,600	249,965	241,600
		Lake Tahoe	732,000	569,000	518,400
	Newton	Newton	5,300	4,900	4,900
	Ogden River	Pine View	44,200	13,085	14,855
	Pine River	Vallecito	126,300	40,800	60,100
	Provo River	Deer Creek	146,800	63,400	73,400
	Scofield	Scofield	65,800	----	7,600
	Strawberry Valley	Strawberry	270,000	120,700	115,200
	Truckee River Storage	Boca	40,900	12,900	[1] 12,000
	Uncompahgre	Taylor Park	106,200	84,500	70,100
	Weber River	Echo	73,900	55,300	55,300
Region 5	Altus	Altus	140,000	11,200	45,500
	Carlsbad	Alamogordo	128,300	31,035	35,600
		Avalon	6,000	5,345	3,200
	Colorado River	Marshall Ford	810,500	641,100	497,400
	Rio Grande	Caballo	345,900	251,020	266,700
		Elephant Butte	1,830,300	1,030,900	513,900
	Tucumcari	Conchas	300,000	323,340	264,900
Region 6	Belle Fourche	Belle Fourche	177,500	144,800	154,800
	Milk River	Fresno	127,200	61,600	136,700
		Nelson	66,800	28,600	27,000
		Sherburne Lakes	66,100	24,100	23,400
	Riverton	Bull Lake	152,000	48,300	69,500
		Pilot Butte	31,500	18,800	15,400
	Shoshone	Buffalo Bill	456,600	349,800	291,900
	Sun River	Gibson	105,000	68,900	58,600
		Pishkun	32,050	22,800	17,200
		Willow Creek	32,400	11,200	15,300
Region 7	Colorado-Big Thompson	Green Mountain	146,900	56,400	64,700
	Kendrick	Alcova	190,500	37,600	83,700
		Seminoe	970,000	543,000	289,200
	North Platte	Guernsey	41,050	41,900	31,700
		Lake Alice	11,000	----	5,800
		Lake Minatare	57,000	29,000	20,900
		Pathfinder	1,040,500	418,700	472,900

[1] Estimated.

RECLAMATION READING

Bureau Publications

New Folder

Electric Power from the Columbia Basin Reclamation Project.—A 12-page illustrated folder featuring a step-by-step description of the creation of the world's largest power plant at Grand Coulee Dam, and telling the story of the dam as a producer of power for war and peace. Copies available upon request to the district manager, Columbia Basin Project, Coulee Dam, Wash.

Miscellaneous Publications

"Our Oldest Public Utilities," by Harold F. Webb, in *National Safety News*, January 1947, page 22. Illustrated. Suggestions for a simple and practical safety program in the administration of water supply systems—oldest of all types of public utilities.

"The Industrial Future of China," by Dr. V. K. Wellington Koo, Chinese Ambassador to the United States, in *Industrial Standardization*, January 1947, page 4. Program of industrialization realized through imports of machinery is expected to open China's markets in an epic story of development similar to that of America's West.

Production of Electric Energy and Capacity of Generating Plants in the United States, 1945, prepared by the Federal Power Commission, 25 pages with illustrations. Publication presents information on the 1945 production and corresponding installed capacity of generating plants operated by electric utilities and other organizations producing electric energy for public use. Twenty-five cents a copy from the Federal Power Commission, Washington, D. C.

Bibliography of Agriculture, publications of the United States Department of Agriculture, State agricultural experiment stations, State agricultural extension services, and books and pamphlets from other sources listed by the Departmental library. 192 pages (mimeographed) with author and subject indexes—January 1947, vol. 10, No. 1. (Forty cents a copy from the Superintendent of Documents, Washington, D. C.)

"Operating Programs of the Bureau of Reclamation—Service for Water Users," by Alfred R. Golze, Assistant Director, Branch of Operation and Maintenance, Bureau of Reclamation, in the *Western States Reclamation Journal*, January 31, 1947, page 6. Illustrated.

Engineering Publications

Available from the Design and Construction Technical Library, Bureau of Reclamation, Customhouse, Denver, Colo.

Hydraulic Roughness Coefficients For Large Channels (Isthmian Canal Studies Memorandum 106) Panama Canal, Diablo Heights, C. Z., November 1946. The velocities of flow that may be produced in large channels, and the differences in water level that produce these velocities, are of prime importance in the selection, design, and operation of any trans-isthmian canal, particularly a sea-level type of canal. Estimates of these important factors are obtained from computations for which a roughness coefficient or factor must be chosen. This memorandum is divided into five parts, as follows: Part I—General; Part II—Open-channel flow formulas; Part III—Measurement of hydraulic roughness in Gaillard Cut; Part IV—Roughness data on large channels; and Part V—Recommended roughness values for Isthmian Canal Studies—1947.

Some Remarks About Seepage of Water From Canals on to Deep Soil, by George Hamel, Berlin. (Translated from Zeitschrift fur Angewandte Mathematik und Mechanik (1937). Vol. 18, p. 39). The problem of seepage from canals or channels in sandy soil, in which Darcy's law of permeability is valid, is solved in its entirety by means of simple theoretical functions.

Seepage from Canals, by Ing. Dr. R. Dachler (Translation, Bureau of Reclamation Library). This article establishes the connection between the quantity of water seeping through a unit length of canal, its cross-sectional shape, and the permeability of the material.

Determination of Run-off from Rainfall on Punjab Catchments, by Kanwar Sain and I. P. Kapila, *Proceedings of the Punjab Engineering Congress*, 1946. A study of the rainfall and run-off data of a number of catchments in the Punjab, India, with the object of determining the general suitability of empirical formulae for the prediction of run-off. The conclusion is that each stream is a law unto itself.

The Fortune Tellers

(*Continued from Page 114*)

of the average. Four major reservoirs are 33 percent full, as compared with a normal of 46 percent.

Oregon

Water supplies in many areas will be about comparable to 1944; 72 percent of irrigated lands will have good-to-fair supplies; these are served chiefly from reservoirs holding substantial carry-over from 1946. Most lands dependent upon unregulated stream flow will have supplies ranging from fair to deficient. Mountain snow cover is below average on 91 percent of all measured snow courses, and if precipitation during the run-off season is normal or less, stream flow below normal is certain for all streams except Hood River and Wallowa River. However, water-shed soils are wetter than average, thus favoring flow from the deficient snow pack. Crop land soil moisture is generally good, with fallow lands showing better than average. About three-fourths (73 percent) of the more important reservoirs are half-full or better; the general picture as regards storage is slightly better than the 10-year average—73 percent of total capacity as compared with 70 percent average.

Utah

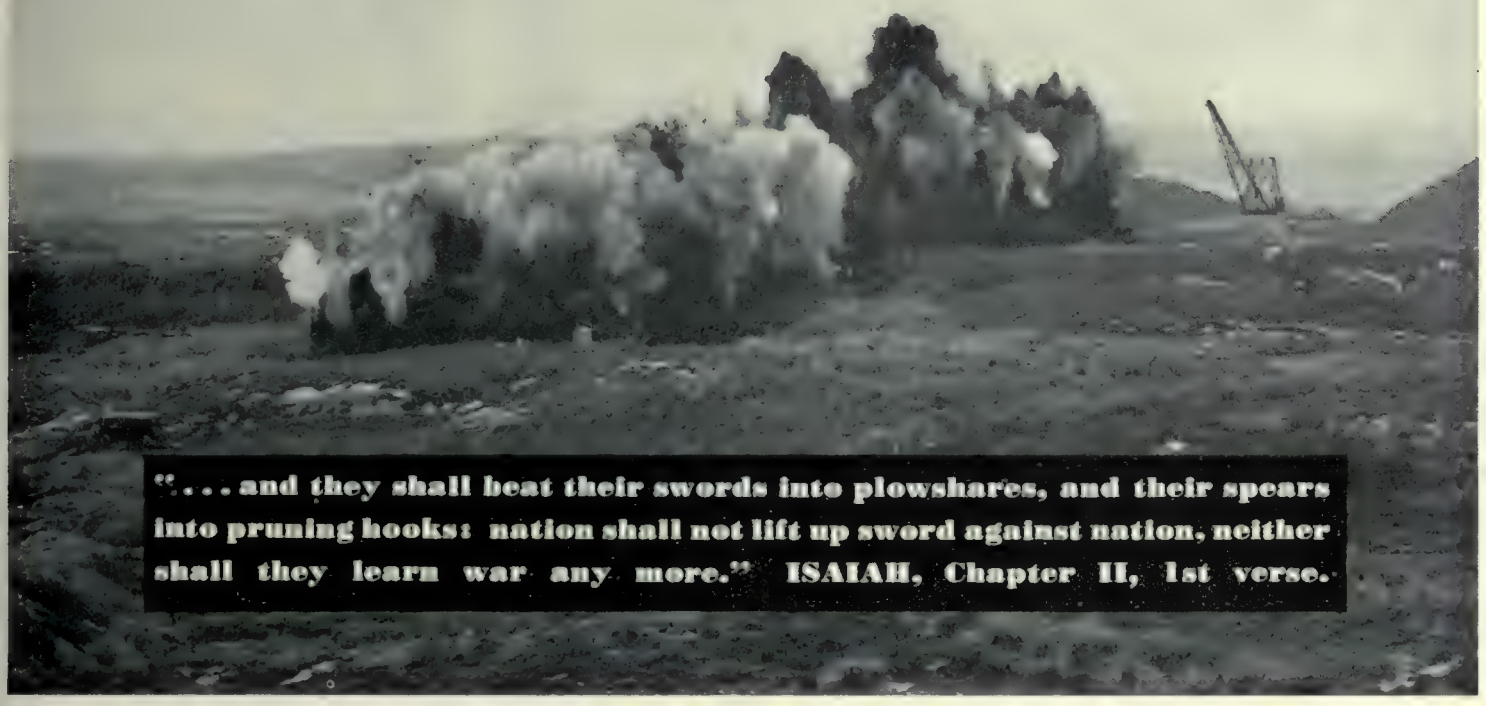
Most watersheds will yield satisfactory irrigation supplies. While total run-off, including flood waters, may be lower than normal, stream flow is expected to hold up through the late irrigation season. April–September run-off will range from 70 percent of the 1936–45 average for Price River (near Heiner) to 132 percent for Strawberry River (near Duchesne). Storage is at a high point, with the principal reservoirs showing storage totaling 72.4 percent of capacity. Utah Lake and Bear Lake are at the highest levels in many years. Storage users should, therefore, have adequate water with the possible exception of those on Price River, as the holdover in Scofield reservoir is very low.

Washington

Prospects are for supplies ranging generally from somewhat above to only slightly below normal. Storage generally exceeds the 1936–45 average, five principal reservoirs being 94 percent full as compared with the 10-year average of 65 percent.

(*Continued on page 120*)

Columbia Basin's Peacetime Arsenal


"... and they shall beat their swords into plowshares, and their spears into pruning hooks: nation shall not lift up sword against nation, neither shall they learn war any more." ISAIAH, Chapter II, 1st verse.

by E. R. Nicolai

Columbia Basin Project Office, Coulee Dam, Wash., Region I

SURPLUS WAR EQUIPMENT, ranging from fragile slide rules to massive power shovels, has been marshalled along a 140-mile front in eastern Washington to speed construction of the Bureau of Reclamation's largest development—the Columbia Basin irrigation project.

Probably no other area in the world has seen so much surplus equipment converted to peacetime use in so little time.

From the Grand Coulee Dam, on the north, down to Pasco, more than 100 miles to the south, equipment designed for winning wars is paving the way for delivery of irrigation water to the million-acre expanse. In saving millions of dollars for taxpayers, the Bureau also has helped contractors get an earlier start on the task of carving canals and foundations for dams from the stubborn basalt of the famed Big Bend region.

Quonset huts, purchased from the Army, have averted a critical housing situation at several contractors' camps. Surplus water tanks and large consignments of "invasion pipe" have been assembled to accelerate construction of necessary utilities. Trenches for the pipes were dug with an Army-type excavator, and the fittings, as well as the wrenches used to handle them, came from surplus stocks.

Bureau of Reclamation engineers and advance crews of construction forces ramble over the hills and down the coulees of eastern Washington's rugged countryside in surplus ambulances, jeeps, and weapon carriers. Surveys are made with one-time Army transits, and sites are marked with flags fashioned from Navy surplus bunting.

None of the great quantities of surplus equipment obtained for the Columbia Basin project is "surplus" after it reaches the Bureau. Many uses are found for virtually every item. Airplane hangars have been assembled at the Grand Coulee Dam to protect equipment and to service rolling stock. Odds and ends of steel from these hangars were used for various repair jobs.

Bomb shelters of "elephant" steel have been converted to equally placid tasks. Some of the steel forms a trash burner for the Bureau's sawmill at Coulee Dam. Other sections, covered with soil, protect war-surplus dynamite.

The conversion list is almost endless. "Bailey Bridges," built to carry troops and vehicles across European streams, now cross the river-size Main Canal of the project. Circus-size tents, designed originally as temporary hangars for aircraft, were thrown over the Grand Coulee Dam pumping plant last winter to protect workers and to keep cold air from freshly placed concrete.

This summer, when blistering winds push across the basin, workers will be cooled by refreshing drinks of water carried in insulated containers designed by the Army to transport milk to troops. And after completing their day's work in the basin, the engineers will write their reports in temporary offices containing surplus doors, windows, nails, roofing, flooring, electrical fixtures, and desks. They'll be using their war-surplus slide rules, triangles, and other office equipment in preparing field data.

Behind the acquisition and the highly effective use of the great quantity of war-surplus equipment on the Columbia Basin project is a ruddy-faced, jovial man—W. C. Rice, property management officer, who was drafted by District Manager F. A. Banks to "scout" for needed equipment and supplies. In his 25,000 miles of travel as a bargain hunter, Rice has journeyed by train, boat, automobile, and plane. His field has covered depots of the War Assets Administration, the Army, Navy, Treasury Depart-

Army bulldozers in a new role.

ment, and Department of Commerce. His itinerary, on a typical scouting trip might include Seattle, Tacoma, Fort Lewis, Portland, Pasco, San Francisco, or even Honolulu.

Looking from his office window in the shadow of man's largest concrete dam, Rice can point to a dozen pieces of war-surplus equipment at work at any time on any day. On the Feeder Canal for the irrigation system, near the dam's west abutment, war-surplus wagon drills are biting into the diamond-hard rock. The air-tool operators wear war-surplus safety goggles, their drills are served with war-surplus air hose, and lubricated with Navy grease. The holes are blasted with war-surplus 40 percent dynamite.

When the drillers' equipment is moved to a new location, it is pulled by a war-surplus truck equipped with a war-surplus derrick.

Down on the Columbia River below his office, Rice can point to other war-surplus materials used on an around-the-clock basis. A squatty sea mule pushes and pulls muck-laden barges. It is manned by a crew wearing self-inflating Navy life belts. The barge it handles is fashioned from a series of watertight cells designed for the Navy.

If a fire should start, Bureau workers will seize Army-surplus fire extinguishers to combat the blaze. If more assistance is needed, a highly mobile jeep, complete with gas masks, hose, and other apparatus, will speed to the scene. If someone is burned in the fire, he will be treated at the scene with one of the several hundred war-surplus first-aid kits.

Use of war-surplus safety equipment has saved many lives on the Columbia Basin project, and likewise has prevented injuries. When two men recently fell from a barge and into the turbulent Columbia River they floated to safety because they wore Navy life belts. Other equipment pointing to greater safety includes small floodlights for illuminating work at night, goggles, life rafts, and mobile cranes for handling bulky objects which ordinarily would carry a high rate of strains and bruises.

Better upkeep of tools, with consequent lowering of injury rates, has resulted from the use of an annealing oven—another surplus item.

In his "little black book," which lists various bargains in war-surplus equipment he has obtained for the Columbia Basin project, Rice tallies off other items: 225 house trailers from the atomic bomb project at Hanford, Wash., and 283 prefabricated and demountable houses from Vancouver, Wash., for temporary housing at Coulee Dam; electrical cable for the Grand Coulee Dam power plant; tropical huts leased to contractors for their construction staffs; portable welding machines for repair and maintenance work at Coulee Dam and elsewhere in the basin; a 50-ton tank-recovery trailer for hauling transformers; and 575 treated ties for the Bureau's short-line railroad.

Despite the great quantity of surplus equipment he has purchased for the Bureau, Rice still adheres rigidly to a two-question formula: "Can we use it efficiently? Can we get enough use out of it to repay its cost?" If the answers to both questions are "yes," then Rice strikes a bargain.

"I had a give-away value the other day, but I turned it down," Rice commented. "The Army offered to sell me three weather-observation balloons for almost nothing. I simply couldn't see any useful application for them, so they were sold to the State penitentiary, but not for escape purposes. They were cut into strips and used for tarpaulins on the prison farm."

A short cut across the Main Canal via Bailey Bridge.

War-seasoned seamule now handles muck-laden barges.

Veteran, Wyoming

History repeats itself as land-hungry veterans of World War II follow the trails blazed by World War I builders of Veteran, Wyo.

By Vaughn Mechau, *Region VII, Denver, Colo.*

As much a part of war as the casualty lists, the suffering, and the insecurity, are the foxhole dreams of soldiers envisoning a place of their own in the country where the fruits of peace can be gratefully enjoyed.

After World War I, thousands of veterans with the help of the Bureau of Reclamation sought and found land where they could put down their roots on places of their own. Following the same cycle of war and peace, the soldier-sons of veterans of World War I now are impatiently laying out on paper their farm unit plans—just as they dreamed of them in the steaming jungles of Pacific islands, or as they huddled, bone-chilled, on some frozen European battlefield.

Now, and in the next few years, approximately 4,500 World War II veterans will have opportunities to settle on public land and 50,000 others on privately owned land on reclamation projects in the 17 Western States, and, through the "know how" earned in both war and peace, make their foxhole dreams come true.

Experiences of World War I saved lives and won battles in World War II. Experiences on irrigated land, learned the hard way by veterans of the first war, will be profitable for the returned soldiers of World War II.

The dreams of soldiers in 1918 materialized in 1921 when the first unit of the Goshen irrigation district, southwest of Torrington, Wyo., was opened to veterans. In that year 130 veterans of World War I enthusiastically discarded their olive drab for blue denim. Waters from the North Platte River meant the opposite of all the things war symbolized—life instead of death; construction in place of destruction.

So proud were the veterans of their new community that they petitioned the Union Pacific Railroad to change the name of the neighboring railhead to Veteran. Veteran was to be the shipping point for their produce—it was to be their village, their town, and in the future, their city.

Today Veteran stands, not as a shining modern city, but as a small community—an adequate school, a general store and post office, a grain elevator, lumber and feed store, and a few homes. For all its modesty, the town of Veteran is significant because it, too, was a battleground and marks a victory that will lead to future victories and to the successful development of towns and communities.

"Doc" Haas says livestock makes a successful farm.

In 1921, 130 returned soldiers successfully drew lots for units of the new irrigation district. Today, 19 of the original group are still on the land. In the intervening 26 years the former soldiers met and faced the multiple hazards of agriculture.

One of the first handicaps to the successful development of their dream community was the lack of agricultural experience among the settlers. At that time the Bureau of Reclamation did not have legal authority to set up even minimum qualifications for settlers. It was not until such authority was granted by what is commonly known as the "Fact Finders' Act" of December 5, 1924, that standards were set up to guarantee "reasonable assurance of success."

Many soldiers had no conception of the rugged life ahead of them, and were unsuited for the task they had selected for themselves. Those, too, whose minds speculated on selling their lands when necessary improvements were made, hampered the settlement.

Now, 26 years later, there are few of the original settlers left, but those who stuck it out are glad they did.

Today the original settlers are classified by their neighbors all the way from "comfortably well off," to "wealthy and influential." They have contributed to the welfare of their part of Wyoming and to the State as a whole. In the last election, two of the original veterans, Floyd Pease and Glen Hertzler, were elected county treasurer and county commissioner, respectively, of Goshen County. Walter W. Hudson, another original settler, retires this year as speaker of the Wyoming State House of Representatives.

It is from men like these that the veterans of World War II will receive guidance under the new settlement program of the Bureau of Reclamation.

George F. "Doc" Haas, another "original," points out: "Nothing succeeds like success. The best thing a young fellow can do on irrigated land is to follow the pattern and system of successful farmers. Too few of us knew much about irrigated farming when we started here. We had every kind of ex-soldier, from piano tuners to paper hangers.

"Too few of us remembered to forget that there are hours in the day and days in the week. We did not realize there was no let-up in work, season after season."

"Doc" Haas has come to the time in life when he is thinking about retiring—in an active sort of way. To his four grown sons

Evidence of a productive farm in the background

and four daughters, he is turning over the management of his now extensive farm.

"I am not going to to quit work—I am just going to take it a little easier," he said.

Although originally the unit was divided into farms averaging 70 acres, through the process of shaking down and working out profitable plans of operation, the individual farms now are considerably larger, averaging 120 acres.

Alert to the needs of young farmers settling on reclamation land, "Doc" Haas lists the following fundamentals for successful operations.

1. Farm background.
2. Long-range program.
3. Careful planning.
4. Balanced crops and livestock.
5. Utilizing the advice of county agents and agricultural agencies.
6. Vigilance and determination.

"Doc" Haas has the authority to speak. He and his wife moved onto their farm the first winter and underwent hardships as rigorous as most pioneers ever faced. For 6 weeks, that first bitter cold winter, Mrs. Haas never saw another soul besides her husband. A graduate of Kansas State College, Mr. Haas is a veterinarian and was farm-reared, but even these qualifications failed to make easy the hard work of farming. Neither he nor his wife have had a vacation in 10 years.

His rich irrigated acres produce potatoes, sugar beets, beans, alfalfa, corn for ensilage and livestock.

"You have got to have livestock to make a success of farming," he stoutly declares.

"You will find if you check every farm in this community that the ones having livestock are the successful ones. My Angus herd is fed from my land. They eat beet tops, beet pulp, and alfalfa. In return they give me fertilizer for the land and a cream check every month sufficient for running expenses of the farm. It took a long time to learn that livestock is vital to irrigated farms but you all see that those who follow that pattern, whether they are small or large operators, are successful," Haas said.

The veteran farmer warned against the evils of tenancy in newly created irrigated communities.

"Many of the boys put tenants on their places after they had become discouraged," Haas said, "and it not only hurt them but it hurt everyone else in the community as well. I have never known a tenant to have the same interest in a farm as the man who intends to make his farm his home. Equally detrimental is the large operator who mines the land for everything he can get out of it and seldom puts anything back in the soil," he added.

Haas urged the careful selection of examining boards for consideration of veterans for settlement projects. "They cannot put too much emphasis on farm experience," he declared.

"The examining board must consider that its action not only involves the lives of the applicants themselves, but has a definite bearing on the community, the State, and the Nation," said the veteran farmer. He ought to know about the life of a farming veteran.

He was there.

The Fortune Tellers

(*Continued from Page 116*)

Plenty of water in the main stem of Columbia River appears assured for generation of electric power; high river stages and some flood damage may, in fact, occur.

Wyoming

Prospects as regards both run-off and storage average better than normal. Run-off of five principal streams will be as follows: Shoshone, below reservoir, 133 percent of the 1936–45 average; Big Horn, at Riverton, 115; Popo Agie, at Riverton, 97; North Platte, at Saratoga, 97; Laramie, at Jelm, 123. Eight principal reservoirs are 45 percent full, as compared with the 10-year average of 25 percent.

British Columbia

Above-normal run-off is expected for all streams in the Kootenai-Columbia Basin, including Okanagan. North Thompson River at Barriere and Powell River on the coast should also flow above normal. Indications are that an early breakup is ahead, the flow of some streams being above normal. At all snow courses the ground is moist and not frozen beneath the snow cover.

Great Plains States

Storage in one South Dakota reservoir is 78 percent of capacity, as compared with an average of 44 percent. Three Nebraska reservoirs are 58 percent full; average 17 percent. One Oklahoma reservoir is 32 percent full. Two Texas reservoirs are 79 percent full; average 80 percent.

Detailed Forecast Available

Reports detailing the results upon which the foregoing summaries are based may be obtained by addressing the Division of Irrigation and Water Conservation, Soil Conservation Service, College Hill, Box D, Logan, Utah. Requests should identify the State or drainage basin about which information is desired.

The table on page 115 lists the reservoirs of the Bureau of Reclamation, their active storage capacities, and the amounts of water in storage on March 31, 1946, and on the same date this year. In the Pacific Northwest and in the northern Rocky Mountain region, the reservoirs are being filled sufficiently to assure enough irrigation water supply to mature crops this year. In the southwest, the six reservoirs of the Salt River Project in Arizona have about 220,000 acre-feet less storage than a year ago, and the lowest storage for March since 1940. The storage in Lake Mead is about 1,390,000 acre-feet less than a year ago, and lowest for March since 1938. On the Orland project in central California, the storage reserves are 30,000 acre-feet less than last year, and lowest for March since 1933. With its depleted reserves, the Carlsbad project has only about 4,000 acre-feet more storage than it had in March last year.

U. S. GOVERNMENT PRINTING OFFICE: 1947

NOTES FOR CONTRACTORS

Contracts Awarded During March 1947

Specification No.	Project and State	Award date	Description of work	Contractor's name and address	Contract amount
1551	Shoshone, Wyoming	Mar. 12	Main control board, distribution board and accessories	Control Corp., Minneapolis, Minn	$51,403.00
1555	Missouri Basin and Colorado-Big Thompson.	Mar. 6	High pressure gate assemblies for Enders Dam and Estes power plant.	Willamette Iron & Steel Co., Portland, Oreg	93,987.00
1570 [1]	Colorado-Big Thompson, Colorado.	Mar. 28	Construction of Marys Lake and Estes power plants and switchyards.	Peter Kiewit and Morrison-Knudsen, Omaha, Nebr	2,176,708.00
1570 [2]	do	Mar. 3	Construction of Aspen Creek siphon Marys Lake Reservoir, Prospect Mountain conduit.	Horner and Switzer, Denver, Colo	1,611,953.00
1575 [3]	Central Valley, California	Mar. 4	Electrical equipment for Ygnacio and Clayton Canal pumping plant.	Standard Transformer Co., Warren, Ohio	22,069.00
1576	Missouri Basin, Wyoming	Mar. 20	Three 13,333-kilovolt-ampere generators and accessories for Kortes.	Elliott Co., Jeanette, Pa	501,711.00
1585 [3]	Colorado-Big Thompson, Colorado.	Mar. 17	Construction of Granby pumping plant	Granby Constructors, Colorado Springs, Colo	4,139,998.00
1587	Denver, Colorado	Mar. 4	Testing machine with 5,000,000-pound capacity	Baldwin Locomotive Works, Eddystone, Pa	339,775.00
1588	Yakima-Roza, Washington	Mar. 11	Construction of manifolds, discharge pipe lines and structures.	Scheumann & Johnson, Seattle, Wash	773,131.00
1595	Central Valley, California	Mar. 3	One 30-ton 1,380-foot span cableway for Shasta Dam	Washington Iron Works, Seattle, Wash	81,446.00
1611	Missouri Basin, Wyoming	Mar. 7	Three 108-inch steel penstocks and accessories for Kortes.	Darby Products of Steel Plate Corp., Kansas City, Kans.	78,856.00
1623	Yakima-Roza, Washington	Mar. 21	Construction of lateral distribution system, areas 15, 16, and 17.	J. A. Terteling & Sons, Inc., Boise, Idaho	224,453.00
1624	Central Valley, California	Mar. 4	Construction of Los Medanos wasteway extension	M. W. Brown, Redding, Calif	11,849.50
1625	Missouri Basin, Montana	Mar. 24	Erecting 5 steel huts and constructing utilities, Miles City	Jayhawk Construction Co., Billings, Mont	25,904.75
1627	Hungry Horse, Montana	Mar. 12	Construction of 12.47 kilovolt transmission line and distribution system.	Olson Construction Co., Salt Lake City, Utah	49,155.00
1628	Boulder Canyon, Arizona-Nevada.	Mar. 19	Construction of utilities for Boulder City	H. W. Polk, Las Vegas, Nev	111,538.00
1629	Missouri Basin, Montana	Mar. 13	Erecting 5 steel huts and utilities at Hardin	Wm. J. Frates Construction Co., Billings, Mont	28,468.30
1634	Fort Peck, Montana	Mar. 28	Electrical equipment for Wibaux substation	Standard Transformer Co., Warren, Ohio	11,200.35
1640 [4]	Davis Dam, Arizona-Nevada	Mar. 3	10 transformers and disconnecting switches	do	10,333.80
1650	Central Valley, California	Mar. 10	Test piling for Delta Mendota pumping plant	Underground Construction Co., Oakland, Calif	19,201.00
1658	Boise-Anderson Ranch, Idaho	Mar. 11	2 radial gates and hoists for spillway	Valley Iron Works, Yakima, Wash	18,200.00
1661 [5]	Central Valley, California	Mar. 14	11 20- by 17-foot radial gates	Berkeley Steel Construction Co., Inc., Berkeley, Calif	26,620.00
1661 [6]	do	Mar. 14	11 radial gate hoists	Pacific Coast Engineering Co., Alameda, Calif	29,700.00
R2-6	Region II, California	Mar. 17	Moving and converting buildings and constructing water system.	Paul Spencer Construction Co., Los Angeles, Calif	43,624.70
7461-A-1	Davis Dam, Arizona-Nevada	Mar. 27	Reinforcement bars	Capitol Steel & Iron Co., Oklahoma City, Okla	51,310.43
7478-A	do	Mar. 21	do	Sheffield Steel Corp., Kansas City, Mo	93,242.16
G-38,213-A	Columbia Basin, Washington	Mar. 21	15,530 feet power cable	General Electric Co., Denver, Colo	61,737.36
G 38.234-A	do	Mar. 5	1,000 tons reinforcement bars	Southwest Steel Rolling Mills, Los Angeles, Calif	89,000.00
G-38.235-A	do	Mar. 5	do	do	91,000.00
G 38.237-A	do	Mar. 28	30,000 barrels portland cement	Lehigh Portland Cement Co., Chicago, Ill	100,848.00
G 38,241-A	do	Mar. 6	Reinforcement bars	Sheffield Steel Corp., Kansas City, Mo	56,180.73
G 38,247-A	do	Mar. 20	do	do	120,539.58
G-46,375-A	Colorado-Big Thompson, Colorado.	Mar. 27	33,100 barrels portland cement	Colorado Portland Cement Co., Denver, Colo	93,060.65

[1] Schedules 1, 2, 3. [2] Schedules 4, 5. [3] Schedule 1. [4] Schedules 1, 2. [5] Item 1. [6] Item 2.

Construction and Supplies for Which Bids Will be Requested During May 1947

Estimated date bids to be invited	Estimated date bids to be opened	Project	Description of work or material
May 1	June 5	Central Valley, California	Construction Tracy pumping plant.
Do	do	do	20- by 17-foot radial gates and hoists, Delta-Mendota Canal, station L-185 to L-774.
Do	do	Colorado-Big Thompson, Colorado	Motor controls and switch gear for Granby pumping plant.
Do	do	Columbia Basin, Washington	Motor control equipment for Quincy pumping plant.
Do	do	do	Motors for Quincy pumping plant.
Do	do	do	Earthwork, concrete lining, and structures—Potholes East Canal, station 30+00 to station 376+30.
Do	do	do	Earthwork, concrete lining, and structures—West Canal, station 351+ to station 383+ and station 509+ to station 1229+19
Do	do	Davis Dam, Arizona	Control board for Phoenix substation.
May 5	June 9	Columbia Basin, Washington	Construction Soap Lake siphon—West Canal—station 383+.
Do	do	Yakima-Roza, Washington	Earthwork, pipelines, and structures—lateral distribution system—pump areas 2, 5, 6, and 7.
May 12	June 16	Boise-Payette, Idaho	Earthwork and structures—"C" Line West laterals 1.6 to 23.5.
May 15	June 19	Central Valley, California	Coupling capacitors with potential devices and carrier line traps for Keswick and Shasta switchyards.
Do	do	do	Earthwork, pipelines, and structures—laterals 4.8, 5.3, 5.9, and 6.0 and sublaterals—Contra Costa lateral system.
Do	do	Colorado-Big Thompson, Colorado	Materials for Loveland-Greeley 115-kilovolt transmission line (30 miles).
Do	do	do	Unit substation and pump boards for Granby pumping plant.
Do	do	Columbia Basin, Washington	Construction Burbank pumping plant.
Do	do	do	Oil and water storage tanks, Grand Coulee power plant.
Do	do	do	23-foot pipe, Soap Lake siphon, West Canal.
Do	do	Davis Dam, Arizona	Bus structures and generator protective equipment for Davis power plant.
Do	do	do	Materials for Parker-Pilot Knob 161-kilovolt transmission line (125 miles).
Do	do	do	Materials for Prescott-Phoenix 230-kilovolt transmission line (75 miles).
Do	do	do	Materials for Tucson-Cochise 115-kilovolt transmission line (80 miles).
Do	do	do	Materials for Parker-Davis 230-kilovolt transmission line (80 miles).
Do	do	do	Materials for Davis-Prescott 230-kilovolt transmission line (140 miles).
Do	do	Missouri Basin, Angostura, South Dakota	54- by 72-inch outlet pipes, Angostura Dam.
Do	do	Missouri Basin, Kortes, Wyoming	3 96-inch ring follower gates, Kortes Dam and power plant.
Do	do	do	Drain lines, Kortes Dam and power plant.
Do	do	Provo River, Utah	Construction Jordan Narrows pumping plant.
May 20	June 24	Columbia Basin, Washington	Station auxiliary power boards a. c. and d. c. for Grand Coulee right power plant.
May 22	June 26	Deschutes, Oregon	Earthwork and structures—laterals M-57 to M-64-A and sublaterals.
May 27	July 1	Columbia Basin, Washington	Jet pumps, Grand Coulee right power plant.
May 29	July 3	Provo River-Deer Creek, Utah	Bypass with energy absorber, Jordan Narrows pumping plant.
May 30	do	Central Valley, California	Main and station service control boards for Tracy substation.
Do	do	do	Motor control and station service boards for Tracy pumping plant.
Do	do	Columbia Basin, Washington	Unit and main control boards for Grand Coulee right power plant.

THREE-WAY AGRICULTURE, Boise project, Idaho

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Featuring:

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FORTY-THREE YEARS on the Shoshone Project

●

BRAHMAN CATTLE

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RECLAMATION and the Housing Shortage

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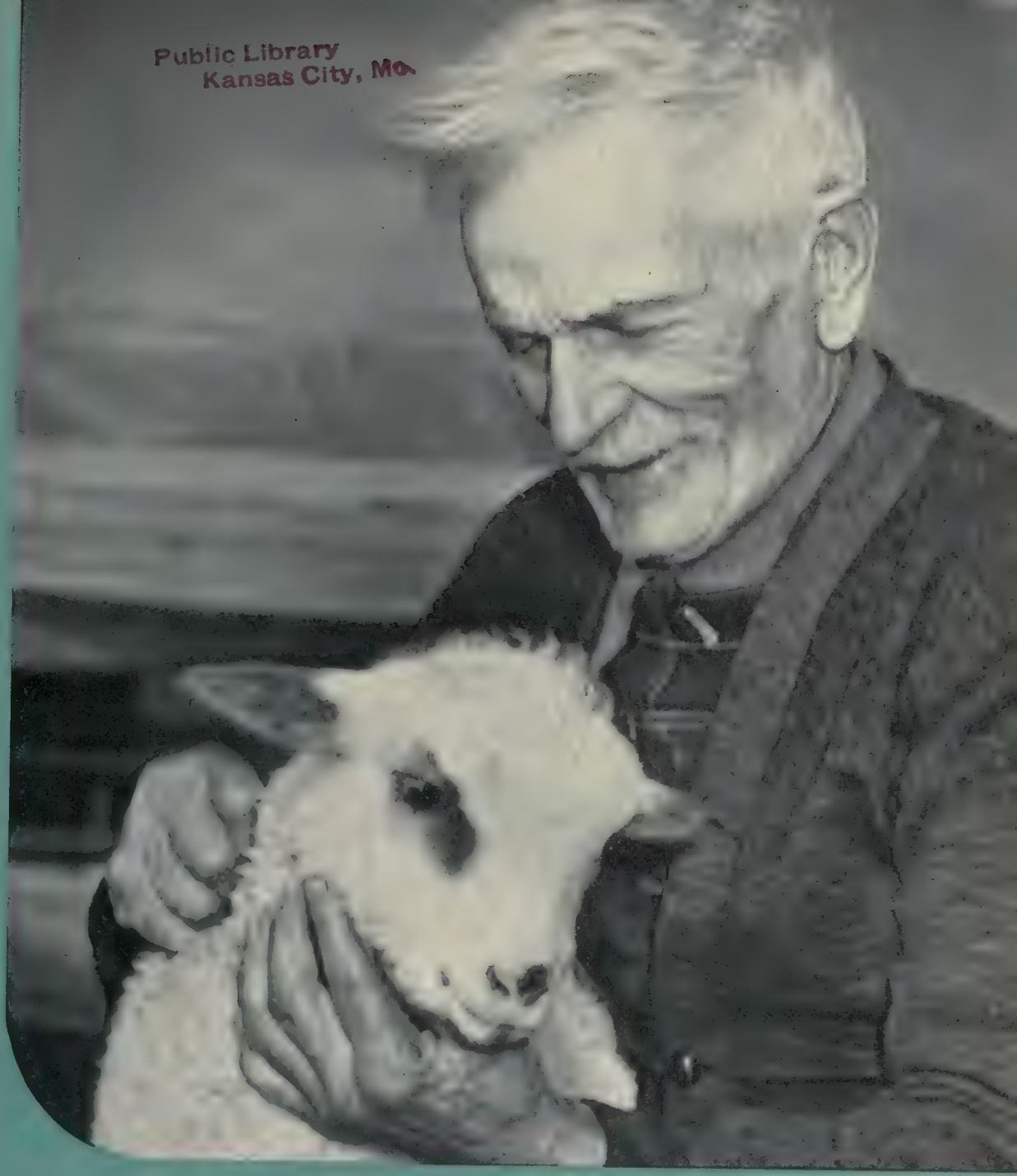

THE Reclamation ERA

United States Department of the Interior

J. A. Krug, Secretary

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The Reclamation Era will continue to make its mailing facilities available for distribution of the Personnel and Project Directory. However, in order to comply with the President's program, the directory will be published semiannually, instead of quarterly, until further notice. We plan to be able to distribute the directory with the September 1947 issue.

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"Realistic Abundance"

Secretary Of Agriculture Clinton P. Anderson, speaking before the House Committee on Agriculture, April 21, 1947, made the following remarks which are printed here as a matter of interest to reclamationists:

"As my contribution today I want to outline what I believe to be the one practical policy for American agriculture—a policy of organized, sustained, and realistic abundance. I want to show you the opportunity we have now, at long last, to establish and maintain a balance between consumption and the sound capacity output of our agricultural plant. This is an opportunity not only to serve the general welfare but also, and not incidentally, to serve the best interests of United States farm people.

"Now, how much food and fiber do we need?

"I have looked at that question from a number of different angles, and the answer I get each time is that we need more than we have ever had. Look at it from the nutritionist's standpoint, and it's clear that many people need greater farm production in order to have adequate diets. Look at it from the standpoint of economics, and you see both potential markets and productive power which would, if brought together, mean profitable exchange and an expanding economy. * * *

Assuming that the buying of families with prewar incomes of $2,000 or more—the upper 40 percent of our income groups—represents what the people of the United States want, and applying their buying habits to the whole population, it is indicated:

"* * * that people want about 40 pounds more meat per capita than they were getting between 1937 and 1941; they want over 200 pounds apiece more milk, about 9 pounds more chicken, 23 or 24 pounds more fresh vegetables, around 17 pounds more processed vegetables, an additional 50 pounds of citrus fruit, and over 80 pounds more of other fruits. * * * I believe it is safe to assume that they would buy more products made from cotton, tobacco, and wool, although we do not have the precise measure for these products that compare with those I have just given for food.

"Total up the wants of our people, add in conservative amounts for exports, imports, and industrial uses, allow for good yields, and here's the picture: We would need more than 420 million acres for crops, orchards, rotation pasture, and fallow land. That is almost exactly what our production goals call for this year. It's around 10 million acres higher than the comparable figure for last year or for the 1937–41 average. It's the continuing acreage we would need if people of reasonable income could buy what they have shown they want.

"* * * Judging what the whole population wants by the actual food buying habits of persons in the upper 40 percent of our prewar income groups, our people would like to be able to buy a third more food than they had on the average in the five prewar years 1935–39. Last year our food consumption level was already 16 percent above prewar. So, as a result of increased consumer income and increased farm production, we have gone about half way toward suplying people's wants that were not being satisfied in the prewar years. * * *

"What our studies and experience boil down to is one simple fact: By supplying only the reasonable needs of our own people and reasonably expected export and industrial markets, we cannot only market as much agricultural production as we have now but can actually expand. We can do it profitably and with progressive improvement of our natural resources.

"Preliminary results of a current study in the Department of Agriculture show that of the crop land used to produce the civilian diet in the war years 1943 through 1945, about 80 percent was used in the production of livestock products; not more than 20 percent of the land that produced civilian food was devoted to crops for direct human consumption. The same study indicates that with present yields we would not have enough crop land to support our present population if all of us ate the same high-grade diet that our high-income families eat. * * * At average yields, it takes the product of only about two acres a person to produce the food for a low-income diet, while it takes 3 acres or more per person to supply the food for a liberal diet. It takes no imagination to see the possibility of eliminating the old problem of surpluses if we have the means to eat what we really want."

For carrying out a policy of organized, sustained and realistic abundance, Secretary Anderson outlined a broad program, in which the following was one of several major elements:

"The third broad program requirement is an over-all land program to make sure we conserve and improve our agricultural resources. Therein lies the hope for sustained and increasing abundance. * * *"

"Electric power helps to make farming easier and more profitable and farm living more satisfactory, and its extension to new areas is a great stimulant to business. Only half the farm population now has the benefits of this power, and the Rural Electrification Administration self-liquidating loans to cooperatives are in great demand."

FORTY-THREE YEARS O

by H. H. JOHNSON, *Superintendent, Operation and Maintenance, Region VI, Billings, Mont.*

FROM sagebrush flats inhabited only by antelope, prairie dogs, and rattlesnakes to a thriving agricultural community of 5,500 people in one generation, a community producing an annual crop revenue of around $3,000,000—that is the story of the Shoshone Reclamation project in northern Wyoming. It is a story that typifies the utilization through reclamation of the two great resources of the arid West—land and water.

The Shoshone project is an example of the present-day dual-purpose unit, which characterizes the extensive Missouri Basin development, incorporating irrigation and hydroelectric power. As now planned, water stored in the Buffalo Bill Reservoir will pass through two power plants. One, the Shoshone Power Plant, has been in operation for many years, supplying low-cost electric power at wholesale rates to many communities in the area. The other, the Heart Mountain Power Plant, is now under construction. After serving this purpose without loss, that water is then diverted for the irrigation of the lands of the project.

Ultimately the Shoshone Reclamation project will contain an area of approximately 160,000 acres. Three divisions of the project, Garland, Frannie, and Willwood, comprising about 72,000 acres, are completed. The Heart Mountain division of 38,000 acres, principally unentered public land, is now under construction.

It is on this division that the Bureau of Reclamation opened 83 farms for veteran settlement this February. Approximately 300 more farms will be available for entry within the next 3 years. The Oregon Basin division of about 50,000 acres remains for future development.

The agricultural potentialities of the Shoshone River valley were first explored by the early Mormon settlers in the last decade of the nineteenth century. They constructed irrigation works and successfully tilled a fertile area at the mouth of the river, near the towns of Lovell and Cowley. Here the broad Shoshone River valley facilitated easy diversion and simple development.

The greater project for the irrigation of thousands of acres was envisioned by the famous frontiersman—W. F. Cody. Colonel Cody, and his associate, Nate Salisbury, impressed by the great expanse of fertile land, extending from above the town that now bears Cody's name to the lower reaches of the Shoshone River valley, secured a permit for the development of an irrigation project to cover the entire region.

They proceeded first to establish the town of Cody and then constructed the Cody irrigation canal to serve an area in the immediate vicinity. The development was successful and, although not within the Shoshone Reclamation project as known today, was the pioneer unit of the area.

Realizing the need for greater resources to finance an undertaking of the magnitude envisioned in the larger project, Buffalo Bill and his associate relinquished their rights and these were later acquired by the then infant Reclamation Service.

The Shoshone Reclamation project was authorized by the Secretary of the Interior on February 10, 1904. Four months later actual work started on Shoshone Dam, a structure now known as Buffalo Bill Dam in honor of the pioneer who first realized the significant importance of irrigation to the community he had founded. Water was delivered to the first unit of the Garland division on June 1, 1908, and the Shoshone Reclamation project became an actual reality.

Buffalo Bill Dam, a concrete structure 328 feet high, creates a reservoir with a capacity sufficient to supply water to a depth of 2½ feet over each acre within the entire project. Located in the picturesque Shoshone Canyon, only a short distance above the Heart Mountain division, this dam had the distinction for many years of being the highest in the United States. In more recent times it has been dwarfed by such Bureau of Reclamation structures as Hoover, Grand Coulee, Shasta, and other dams.

The early history of the Shoshone project area is associated with Indian lore, stagecoach robberies, livestock feuds, and all the romantic features characterizing the old West.

Railroad service into the region was established during 1901 and 1902. Prior to that time travel was only by stagecoach. Garland, near the eastern extremity of the project, was at one time a thriving town on the stage route between the railroad points in southern Montana and the Big Horn Basin. Garland then offered all the comforts and recreational opportunities desired by the early-day traveller but today little remains of its glamour of the Gay Nineties.

The Launchberry Ranch on Eagle Nest Creek, near the center of the Heart Mountain division, was a major stop on the stage line between Red Lodge, Mont., and Cody, Wyo. Sam Launchberry, who resides on the home ranch established by his father, can still entrance the listener by relating stories associated with the stage-line station. Many years have elapsed since the stagecoach passed that way but the old Red Lodge-Cody trail is still in evidence across the Upper Ralston or Alkali Creek Flat.

THE SHOSHONE PROJECT

Ralston was originally considered and promoted as the principal project town. However, certain economic factors favored the then more central location at Powell, named after Maj. John Wesley Powell, an associate of Buffalo Bill, and the town site was established in 1908. For several years it remained only as a construction camp, with Cody and Garland serving the principal trading and recreational centers. The only mode of transportation, aside from the infrequent trains, was by team and wagon, and a trip from Powell to Cody was then a major undertaking. It is easy to recall how a handcar "borrowed" from the railroad company or the single automobile in the area improvised for service on rails, met with disaster in an attempt to dispute the right-of-way with the one train of the line.

Construction of canal systems with teams and fresnos (scrapers) in the early part of the century was a slow process, and the project necessarily was offered for settlement in relatively small blocks. The first land opening in 1908 comprised a small group of units surrounding Powell. The frontier was then rapidly moving westward and a free homestead was extremely popular.

At that time there were no restrictions as to character, experience, or capital. It was "first come first served" and the only requirement was a homestead right and enough capital to pay the transportation bill at "emigrant rates."

Many of the original homesteaders were "Easterners" lured to the West by the promise of free land and the romance associated with pioneering in the wide open spaces, where by the magic of irrigation the desert in the short period of a year or so could be made (according to the well-worn phrase) to "bloom like a rose."

These early settlers represented almost every vocation from bankers to yodelers, with a few experienced farmers. Many had but a vague comprehension of the trials and tribulations associated with the creation of productive farms from virgin soil. The fact that the cost of building the project had to be returned to the United States Government in a period of 10 years was not considered. What were a few hundred dollars a year compared with the revenue to be derived from bounteous crops which could be harvested from this new land?

For some the glamour was short lived. Difficulties attended the clearing and preparation of the land for water. There were a few years of low productivity before the virgin soil with its shallow zone of fertility could be made to yield abundantly.

Some with insufficient capital and equally insufficient farming "know-how" were forced to abandon their efforts.

On the other hand, many fine farms and comfortable homes on the Shoshone Reclamation project today bear tribute to the pioneers who had the fortitude and endeavor to remain in spite of poor crops, low prices, seepage and the many other vicissitudes of their pioneer era.

New settlers of today will find inspiration and courage in a visit with such men as Frank Kittle, George Kagi, Earl Murray, John Stutzman, Edgar Swallow, Pete Christinsen, and numerous others. They represent the pioneers of the Shoshone project, pioneers who are still in the saddle.

The selection of a farm during these early years of settlement was a major undertaking. No roads were provided to the farm units in order that they might be viewed from the luxury of an automobile seat. No experienced agriculturalist was provided to guide in the selection of the farm or to expound on the technique required to develop a selected site into a profitable farm in the shortest possible time.

Homeseekers were loaded into a spring wagon behind a team of mules and bumped over the sagebrush flats and coulees under the guidance of one Tom Johnson. Tom's principal qualification for the job at the time was that of being a "darned good mule-skinner." He did not know too much about irrigation but he was a pioneer and he knew his way around over the wide-open spaces. He also "knew his mules" and was sure to have his party aboard when they, the mules, decided to go home.

Little was done to assist the new settler. After the selection of his farm he completed his homestead entry, paid his filing fee, and was left more or less to shift for himself. He then proceeded to build his shack as best he could, clear the sagebrush, prepare the land for irrigation, plant, cultivate, and harvest his crop. Building materials were not provided; no agricultural specialist assisted him in planning his farm program. Engineers were of necessity too busy building new works to give aid in such a task as laying out a farm irrigation system.

Few sources of credit were available to the new settlers through the years of meager return. They had to do it the hard way. Those with sufficient stamina were in the majority. The fainthearted quickly went elsewhere and were replaced by the more hardy. The project now stands as a monument to the early twentieth-century pioneer.

Between 1909 and 1918 six additional units were opened on the Garland division. Each successive opening was accompanied

ABOVE: Homestead of John Dowling, 1912.

AT RIGHT: Dowling homestead thirty-five years later.

LEFT: Town of Powell, Wyo., showing main canal, 1909.

BELOW: City of Powell from same spot thirty-seven years later.

by new problems. In solving them, new techniques and needed experience rewarded the efforts of all concerned.

Between 1917 and 1920 the Frannie division, embracing lands principally in Big Horn County between Frannie and Cowley, was opened. Settler selection was then made by lottery and in the later openings the preference was given to World War I veterans.

Unusual difficulties accompanied the settlement and development of the Frannie division. For dogged determination to preserve their homes, in spite of adverse circumstances and without undue complaint, the pioneers of this division stand at the top of the list. New settlers on the Heart Mountain division who may at times experience discouragement can spend a few hours to great advantage visiting some of the early homesteaders on the Frannie division.

The Willwood division, proposed for settlement in several successive blocks between 1927 and 1938, was the first opening under the selective settlement act now in effect. The benefits derived through the process of controlled settlement are now evident. The development of this division occurred during the depression period when agriculture was generally unprofitable and the hunger for new farms practically nonexistent.

Although progress was somewhat slow, it has been steady and the major portion of the first settlers still continue to operate their original entries. While settlement of this division was about 20 years later than the Garland, the stage of development is now almost equal to that of the older unit.

The new settlers of the Heart Mountain division will reap the benefit of these past 43 years of progress in irrigation development. This has been a period of experience in all phases of the enterprise. The irrigation works embrace the most modern engineering skills in design and construction. The farm unit pattern has been developed by agriculturalists experienced in this particular field.

A qualified agriculturist has been employed on the project to assist settlers who desire help in the lay-out of farm irrigation systems and general farm planning. Financial aid in farm development will be available for successful applicants. In order that there may be no duplication of effort, the work of the several agencies, now engaged in the various fields of agricultural training and assistance on the project, will be coordinated in such a manner that the new settler may be assured of the best possible service from trained technicians in any particular field.

The facilities provided for the assistance of the present-day settlers are a far cry from those made available in the mule-team, walking-plow, claim-shack days of the early era. However, the early settler was imbued with a pride of accomplishment, a pioneering instinct which carried him through adversity. With his own hands, and with but little assistance, he wrought fine farms from sagebrush flats and his claim-shack grew into a modern farm home. The settler of today may avoid many of the discouragements of the earlier period, but he will need to preserve the pioneer spirit.

A brief inventory quickly reveals what has been accomplished through this development in the economy of the community, the State of Wyoming, and the Nation as a whole. The cost of the project to the United States, allocated to irrigation facilities, exclusive of the Heart Mountain division, is slightly over $7,500,000, the greater part of which eventually will be repaid. Since 1908, crops valued at $41,300,000 have been produced, which does not include the aditional revenue received from the sale of livestock and livestock products. The project now provides 650 farm homes with a rural population of about 2,000.

The town of Powell has grown from a few shacks in 1908 to a thriving city of 3,250 people and an assessed valuation in 1946 of 1½ million dollars. This principal project city provides educational, recreational, and religious facilities equivalent to that of many midwestern cities of much greater population.

The assessed valuation of the project area in Park County has increased from slightly over $100,000 to more than $6,000,000. In addition the value of 15,000 acres of irrigated lands and improvements in Big Horn County must be added to the value of the project.

About 500 carloads of various commodities originating in almost every State in the Union were imported into the project during 1946, and over 800 carloads of agricultural produce were exported.

This has been the material accomplishment of the past 43 years on the Shoshone Reclamation project and it is only the beginning. Hundreds of satisfied farm families, comfortable farm homes, flourishing small business enterprises, all sustained by a secure water supply, fertile soil and inexpensive electrical energy supplied by project works, witness benefits that cannot be measured in dollars and cents, but all add up to a stabilized national economy.

WHO STARTED IT?

The State of Washington challenges the claim of the State of Utah to the title: "Cradle of American Irrigation"

by Robert W. Fisher, *News Editor, Walla Walla Union-Bulletin, Walla Walla, Wash.*

Any western community claiming that irrigation was used there first must reckon with the Walla Walla Valley in Washington because Dr. Marcus Whitman, missionary doctor, used irrigation successfully beginning in 1841, if not before, and continued it until he was killed in the Whitman massacre of 1847.

The location was some 6 miles west of the present city of Walla Walla at Waiilatpu, the Whitman mission established in 1836. The exact date is not known but it was between 1839 and 1841.

T. J. Farnham, who visited the mission in September 1839, mentioned only that "water from the Walla Walla (river) by capillary attraction was raised to the roots of vegetation," but in 1841 Joseph F. Drayton, member of the Charles Wilkes exploring expedition, stopped at the mission and told of the use of irrigation as follows:

"The Indians have learned the necessity of irrigating their crops, finding that Dr. Whitman's succeeded better than their own. They, therefore desired to take some of the water from his trenches instead of making new ones of their own, which he very naturally refused. They then dug trenches for themselves and stopped up the doctor's. This had well-nigh produced much difficulty but finally they were made to understand that there was enough water for both and they now use it with as much success as the missionaries."

The time must have been about July, for Drayton spoke of wheat nearly ripe and of a fine kitchen garden and of several kinds of fine melons.

Marvin M. Richardson in The Whitman Mission (1940) wrote:

"In one of his letters to the secretary of the American Board written in 1841 (Whitman) proposed to dig ditches around his fields which would serve both for irrigation and to prevent stock from passing." (Stock got into the cultivated fields quite often and did damage.)

Charles J. Bartholet, long-time Washington supervisor of hydraulics wrote in "Building a State" (1940):

"The first reclamation of arid lands in this State by irrigation probably occurred 100 years ago. Records of this department show that Dr. Marcus Whitman constructed a ditch in 1846 to divert water from Doan Creek for irrigation of lands in what became later the Whitman Mission Donation Land claim, located 6 miles west of the city of Walla Walla."

Thomas B. Hill, managing secretary of the Washington State Reclamation Association, Olympia, in a recent letter to me said the 1846 date mentioned by Bartholet "was arrived at by a witness in the adjudication of the water rights on the Walla Walla River and its tributaries. The witness had reason to believe that Dr. Whitman was irrigating before he was killed (1847) and (the witness) probably not knowing definitely when he (Whitman) diverted water from Doan Creek gave the date as near the end of his (Whitman's) labors there."

Dr. Marcus Whitman

This reproduction of the painting of Dr. Whitman by Ernest R. Norling, was made available to the Era *through the courtesy of the Whitman College in Walla Walla, Wash., named in honor of the Doctor. As there were no pictures available of Marcus Whitman, the portrait, made in 1936, is based upon historical descriptions of the missionary, and is a composite of the prevailing characteristics of the Whitman family.*

EDITOR'S NOTE.—Although we are always glad to receive additional and interesting data concerning early irrigation practices, we refer our readers to Dr. John A. Widtsoe's article, *A Century of Irrigation*, in the May ERA for a clarification of the issues involved in discussions of Utah's right to the title of "Cradle of American Irrigation." Also be sure to read the coming accounts of the Utah Centennial Celebration this summer.

A student of early irrigation sheds more light on the subject

by Clifford R. Koester, *Coulee Dam, Wash.*

Recently I have noticed printed statements to the effect that Walla Walla claims the honor of starting modern irrigation through the efforts of Marcus Whitman at Whitman Mission in 1840 or 1841.

Not wishing to detract from the luster of Dr. Whitman's achievements, I believe that a closer examination of the record will show that when the Whitman Mission was established in September 1836, at Waiilatpu, about 6 miles from the present city of Walla Walla, and some 25 miles from old Fort Walla Walla, irrigation was already being conducted from a stream at Fort Walla Walla by the Hudson's Bay Co.

Donald McKenzie, of the North West Fur Co., selected the site of Fort Nez Perces, later known as Fort Walla Walla, in July of 1818. In 1821, Hudson's Bay Co. and the North West Co. merged, with Dr. John McLoughlin the new chief in the Oregon country. While the activities of the Hudson's Bay Co. were of such a nature that encouragement of agricultural pursuits among the Indians would have been ruinous to their business, Gov. Sir George Simpson did entertain plans for making the posts self-supporting. It was to this end that irrigation was being applied at the Walla Walla post; not on a large scale, but nevertheless, a forerunner of Whitman's efforts. (This may be checked by consulting "A History of the Pacific Northwest," by George W. Fuller, p. 326.)

However, Dr. Whitman did a great deal of educational work among the Indians adjacent to the mission. At first, seeing how well his crops grew under this method, they appropriated the water from his ditches for their use. Upon being reprimanded for this, they became angry and caused quite a bit of difficulty by plugging Whitman's headworks and ditches. Later, seeing that there was enough water for everyone, they laid out their own system of ditches with the help of Dr. Whitman, and all were satisfied.

In searching out the history of irrigation in Washington State, as background material for compiling a history of the Columbia Basin project, I find the record often dim and devious, and I offer this for what it may be worth. Some are certain to dispute it because of the dimness.

After reading the article on the following page, you may be interested in next month's story of a well-known western college president's early days as a ditchrider.

Photo by Philip Merritt, Region I

As an artist with deft, sure strokes of his brush transmits to his canvas a lovely picture, so Elma Hill Neal paints a realistic verbal picture with her pen in . . . . .

The Trials and Tribulations of a Ditchrider and His Wife

by Elma Hill Neal

One of the most sorely tried families in the western United States is that of the man who, provincially speaking, lives on a ditchbank, and whose business is that of distributing water over a designated area, tilled and tended by farmers who live under high tension at least 6 months out of the year.

The ditchrider is a peculiar person, a man set apart with an almost professional standing among his farmer constituents. He is trusted and defended, he is cussed and cajoled. The work involved is not difficult, it is seldom monotonous and is more often downright exciting.

From that stated hour when the watermaster orders the water turned in at the head of the canal for the first time in the spring, until the last rows of potatoes and beets are drinking their final drop before digging time in October and early November, the ditchrider has a varied job.

It runs the gamut, from slogging the tumble weeds and muck that ride the foamy crest of the first muddy water tumbling over the dry canal bed in the spring, to the delicate problem of human relationships between farmers in the boiling summer sun.

Twenty years ago, the ditchrider always rode a horse. Before the water season started, he engaged in a series of dickerings and tradings, which usually resulted in a fair bit of horseflesh, one that had plenty of life, but was not skittish, one that could plod away all summer, yet was willing to stand while his master regulated a headgate or plugged a gopher hole.

Following the horse era, on some projects, came that of the light cart, the seat padded with an old jumper or blazer. This afforded the ditchrider more comfort, but he was scorned by some of the older men who considered such luxury as effeminate.

Today on many systems, with broad well-made ditchbanks, jeeps are bounding along, turning abruptly down the steep inclines and jogging over boulders and through fields. They save time, if not wear and tear. Yet scattered throughout the West, one still finds the horse and the cart occasionally in use, although they are both fading gradually out of the picture as the age of mechanization seeps its way into all phases of agriculture.

One of the most crucial times of the water season is the start. After a long winter of freezing and thawing, the winding ditch with its banks, high fills, and sandy spots, is an uncertain affair. During the war years, it was hard to keep a repair crew on hand, and the ditchrider was constantly on the alert, driving to meet the water as it came down, following its surging spread, keeping a sharp lookout for the tiny gopher holes that sucked in the first cold snow water which, if not caught, would soon soften the bank and cause the entire side of the ditch to go out.

Often there were all-night vigils. With April weather just what April weather always is, they were no picnics. Buttoned to the chin in a heavy coat, weed hook and shovel always at hand, the ditchrider, with his eyes trained for closest observation, scanned the dark waters, his ear alert to the softest gurgle that would indicate a seepage. Always the water went through, the ditch soaked up its normal share, the morning came, and the ditchrider, tired to the bone, rode home to a hot breakfast and the hope of a little rest. An idle hope mostly, for from then on the canal was on his mind.

Daily, the ditchrider made his ride. Farmers' wives could set their clocks by the familiar figure moving down the canal. Scribbled notes were left at headgates and tacked on fence posts, ordering water for the day. Occasionally a farmer in irrigating boots hailed him and explained a special order. The South forty was dry. Couldn't seem to get the water over the hump, so wanted a little extra. Spuds were coming up. Peas were blooming.

The banks were green, with bright patches of blue lupine and Indian Paintbrush. The ditchrider spotted a dark object in the water. With his weed hook, he towed it to shore

Photo by Stanley Rasmussen, Region I

Ditchrider George Deck, 77, 32 years with the Wilder Irrigation District, Boise Project, Idaho.

Photo by Stanley Rasmussen, Region 1

Cleaning the gates is a "must" in Deck's line.

and fished the malodorous mass onto the bank. Some farmer's fine ewe had cropped too close to the water's edge. Farther on, he dropped on his knees and bent low over the water to measure an orifice. Still farther on, the canal passed through the Vanderford corral. As he opened the gate, the Vanderford kids stopped their play and ran to meet him. For each he had a bantering remark. The spring air was balmy. The world seemed good.

Because youth and stability are a few of the requirements for a good ditchrider, he is generally in the process of rearing a family. Usually his modest little home is situated near his work. It is a poorly run project that does not afford its riders a reasonably modern house, and furnish them with paint and kalsomine to renovate it yearly.

A telephone is a necessity and babies are born and raised through high-school days in a room where a telephone is a constant source of annoyance, as well as a boon and a blessing. Most ditchriders and watchmen must make morning and evening reports to the watermaster. For possibly an hour, twice a day, the bells are jangling constantly. If the Christenson twins had a simultaneous spell of the colic, the frantic mother was made more frantic. If Wayne Grimmett's 4-year-old Joyce disappeared in the dusk of a lazy June afternoon, when the canal was rolling heavily on toward the thirsty alfalfa fields, the watermaster was informed by phone and made ready to have the water turned out at the nearest diversion point, perhaps to be soon called by the relieved father to say Joyce was found asleep in the clothes closet.

Ditchriders' children grow up with the fear of the big canal always with them. They know that it is swift and deep and whosoever slips in that racing current has little hope of scrambling up its slippery or concrete banks. Yet they seek the quiet waters in some nearby lateral and splash to their heart's content, and long before the accepted age, are swimming like schools of perch, almost as much in their element as when skipping along the dusty road toward home.

The ditchrider's job is his family's job. Each member is alert in his rambles for seeps and gopher holes, knowing a farmer's crop is at stake. There is no record of any modern Hans stopping a leak in a dike, but there are countless sons of ditchriders who go about the routine business of stopping a gopher hole with a shovel and a well-placed chunk of sod in a most unheroic manner. If that isn't possible, they spread an alarm that brings a repair crew.

The ditchrider's troubles are always especially his wife's troubles, and when the Fourth of July pops up on the calendar and the neighbors are planning a fishing trip, she must resign herself to prosaic duties, knowing that the days are getting hot and with the canal brimming full there is more chance than ever of a break, with less help at hand from farmers. It is almost impossible for holidays and Sundays to pass without trouble somewhere on the ride. It is then that she takes over and summons aid, tirelessly calling until she gets enough help.

Because in this northwest county, the seasons are short and a lot of production is crammed into a few months, a farmer's temper is often short. Squabbles over water are the ditchrider's dread. He must be qualified to measure water equitably, but more important, he must be cool-headed and able to make fair decisions quickly. He must know, too, where his authority

Photo by Stanley Rasmussen, Region 1

Mrs. Deck is the home front trouble shooter.

stops, and the farmer's responsibility begins. Many a ditchrider has bit his lip in silence and gone about his business of delivering water, knowing that to give extra to one farmer, means taking extra from another. Many have spent sleepless nights after hard days, trying to figure out some way of settling a matter that seemed impossible of solution.

And so the short summer blends into fall. The water runs smoother and cleaner and clearer. A quiet stillness comes over the land. Asters grow down close to the water, and in the low place behind the fill, cattails grow tall and willowy, and a red-winged blackbird tilts atop a heavy brown spike. From his highway on the ditchbank the ditchrider looks out over the lush green of the potato fields waiting for a killing frost. From over the brow of the hill, comes the faint whirr of a thresher and a thin cloud of chaff blows lazily in the soft air. Stacks of alfalfa hay dot the horizon and give off a musty fragrance. Already the daily orders for water are dwindling. The water in the canal is getting lower. Soon the phones will silence. Soon the beet trucks will be rumbling down the highway. Soon the ditchrider will go out some morning and find a thin crust of ice on a pool of water left in a low place in the canal. Soon comes his rest.

About the Author

Elma Hill Neal says about herself: "I am by education a school teacher with the heart of a farmer.

"Those hours of courting that resulted in my marriage to Ed Neal, were spent mainly on a ditchbank, for water was short on Lost River that summer and had to be measured carefully and doled out sparingly. When the river bed showed dry gravel, we took off on a honeymoon that included all of the irrigation projects in the neighborhood of Yellowstone Park.

"Not including the 4 years spent at the University of Idaho where my husband polished off his education, we have lived in the 'water business' and its people are our people. For five years, I wrote a column in the weekly paper published at Aberdeen, where he was manager of the Aberdeen Springfield Canal Co. But my greatest pride lies in my family of three boys and a girl, with stair-step ages of 15, 16, 17, and 20."

Photo by Stanley Rasmussen, Region 1

Partners, season after season.

BRAHMAN CATTLE

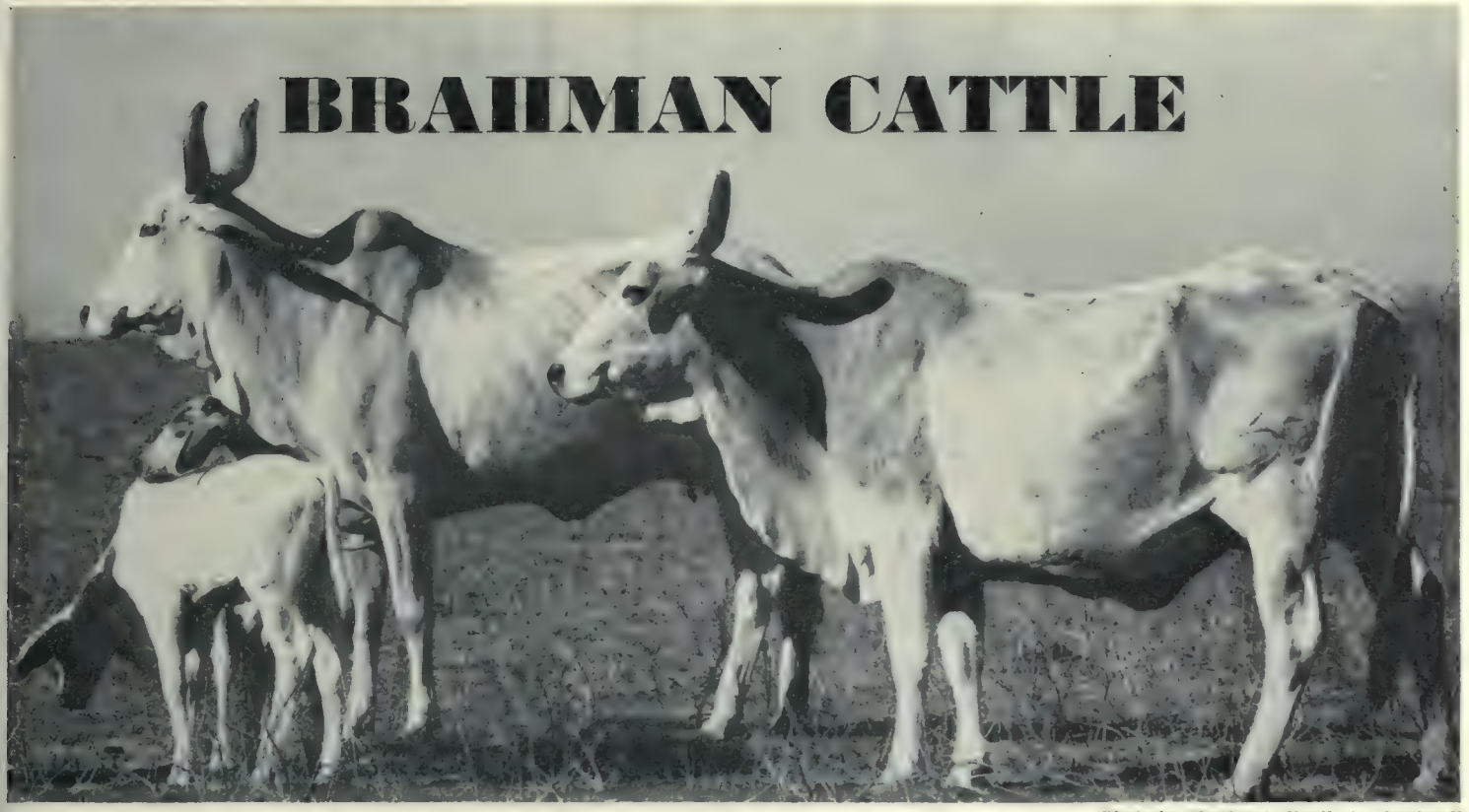


Photo by Charles A. Knell, Jr., Region V

As a good investment, ranchers of the Southwest recommend these descendents of the sacred white bulls of India

DOWN IN THE SEMITROPICAL Lower Rio Grande Valley of Texas, almost 1,800 miles from the Continental Divide in southwest Colorado where the Rio Grande begins its wandering course through New Mexico and Texas to finally spill in the Gulf, Brahman cattle sweat, shake off flies with a shimmy of their thick hides, multiply themselves, and add dollars for their owners with less bother than it takes to tell.

Brahman breeders and the ranchers, who range the descendants of individuals imported from their native India, take issue with the expression "as wild as a Brahman steer."

Brahman cattle may be "as wild as a Brahman steer," or as meek and lovable as a dowager's pet cat. It all depends upon the circumstances. On the range, where wolves and coyotes lurk to nab new-born calves, wildness and a vicious personality are assets. But in the feed lots, up close to the ranch house, in the show ring—wherever Brahmans are treated kindly, they are as affectionate as a Collie pup. Give a tame Brahman half a chance and he'll eat the shirt off your back, or wash your neck and ears with his moist tongue.

Brahmans, because of their agility and their refusal to be pushed around, are used in rodeos to thrill blood-thirsty spectators demanding action. Many cowboy rodeo performers have left their saddles empty in the old corral and prematurely joined their partners on the Range Beyond the Sky, because they zigged when they should have zagged near a Brahman steer.

There are many breeds and types of Brahman cattle. The term "Brahman cattle" is about as generic and broad as the word "horse." Each original breed derived its name from the district in India in which it was bred. Moreover, several distinctive breeds have been developed in the Lower Rio Grande Valley and the Texas Gulf Coastal Plains area by crossing the Brahmans with English breeds, including Herefords, Aberdeen Angus, and Shorthorns. The progeny of the first cross is often bred back to the purebred bull of European origin. The King Ranch in Texas has, by crossing Brahmans with Shorthorns, developed a strain that has achieved the status of a new breed known as Santa Gertrudis. By crossing Brahmans with Shorthorns, this breeding resulted in removing the Brahman humps. Earlier crosses were made with Brahmans and Herefords, and the offspring were called Bradfords.

The offspring of crossbred cattle have the vigor and vitality of the Brahman and the additional beefiness of the English breeds. They are sleek, short-haired, with loose, mellow hides. The hybrid animal is quick maturing and fattens rapidly. They are good feeders as well as excellent range beef stock.

The Brahman is believed to be the oldest of all breeds of cattle, and it is said that more than half of all the cattle in the world are either Brahman or possess some Brahman blood. White bulls of the breed are regarded as sacred by the Brahman caste of India, where they are associated with the Hindu divinity, Brahma. The cattle have endured the famines of India and other countries. Nature obviously fortified them with certain features to withstand heat and ward off insects and other pestilences which affect other breeds of cattle.

Contrary to the claims of any chamber of commerce, it does get hot along the Border and in the Lower Rio Grande Valley. But the hotter it gets, the better the Brahmans like it. Fact is, Brahmans nearly always rest in the sun. Mother range cows drop their calves in areas where they can observe the terrain from all directions and where they can keep their babies in the sun. Moreover, there are no better mothers in the animal kingdom. When mother cows go for water or feed, they summon other cows to stand guard by the babies. When attacked by a predatory animal, the mother Brahman spreads her legs over the calf and rips the attacking beast to shreds with her horns.

Beef Producers

Brahmans, produced primarily for beef, have a very high dressing percentage of meat, well covered, with evenly distributed fat. They are said to be preferred by many packers because their carcasses contain more marketable meat.

Other attributes of Brahman cattle include the early age they attain marketable status, the uniformity with which they de-

(*Continued on page 141*)

RECLAMATION and t

Photo by Stanley Rasmussen, Region 1

This sheet iron form previously used in lining canals is now providing a substantial roof over her head for Mrs. I. D. Lionberger.

WHEN the Bureau of Reclamation is authorized to build a dam in a desert, a reclamation project in a wilderness, or opens land for veteran settlement, construction workers, irrigation farmers, and Bureau employees are faced with housing problems far exceeding those of the East. For when "the wide open spaces" of the West reveal no shelter for hundreds of miles, then reclamationists get busy.

If private facilities are not available, and local interests cannot or will not build dwellings where they are needed, then the Bureau tries to provide the most economical and habitable dwellings possible for its employees, who rent the quarters thus made available at fixed rates set by Interior Department policy.

The Bureau has always constructed permanent buildings, sewers, sidewalks and other utilities, for the maintenance staffs which will be permanently located at the construction site. Temporary buildings are erected with an eye toward moving them out again, and using what can be salvaged for another project. Nothing goes to waste if the supply people, engineers, and other Bureau of Reclamation employees can help it.

But the postwar housing crisis added to the Bureau's already complicated reclamation program. Shortages of materials, labor, and rising prices hit the Bureau as hard as any other agency in the country. Reclamation farmers on projects being constructed, or already built, found themselves faced with land—lots of land—but no houses for the returning veteran, his wife or family, for the children who had grown and wanted to set out on a farm of their own, for the people from the East, who recalled Horace Greeley's recommendation, or for those who, in the atomic age, were seeking solace in the soil.

Out of these emergencies came some solutions to the problem. Commissioner of Reclamation Michael W. Straus, speaking before the House Subcommittee on Appropriations this spring, mentioned one activity of the Bureau which helped solve the housing situation for many people in the reclamation area, especially veterans of World War II who are now homesteading on reclamation land, or employed by the Bureau. Mr. Straus said, "* * * the Bureau was specifically requested to use surplus Government war property to the limit. That policy was further implemented by the Congress in turning over to the Bureau certain abandoned Government-owned Japanese War Relocation Authority camps and a prisoner-of-war camp. We are getting full utility out of this otherwise lost property. Outside Denver there is an abandoned war-surplus Government-owned ammunition loading plant into which we are moving our engineering headquarters and testing laboratory. It is a fortunate arrangement that gets us needed space in otherwise wasted property and at the same time releases commercial space in crowded Denver."

Trailers proved the "number one remedy" in providing homes for workers at

Here are a few examples of the house-hunting, house-building, salvaging, and converting program of people in the reclamation area.

The scarcity of building materials is working a hardship especially on new settlers in the reclamation area. On the Roza Division of the Yakima project in south central Washington the situation is particularly acute. Mrs. I. D. Lionberger and her husband ingeniously solved their difficulty by turning upside down and making into an annex a heavy 16-gauge sheet iron form used in concreting a canal for the new 72,000-acre area. The forms, 10 feet long and 9 feet high, are practically indestructible. They are also being used by other residents of the Roza as chicken houses, cow and feed sheds and as other farm buildings.

Trailers

The ubiquitous trailer seemed to be the most widely used and popular answer to

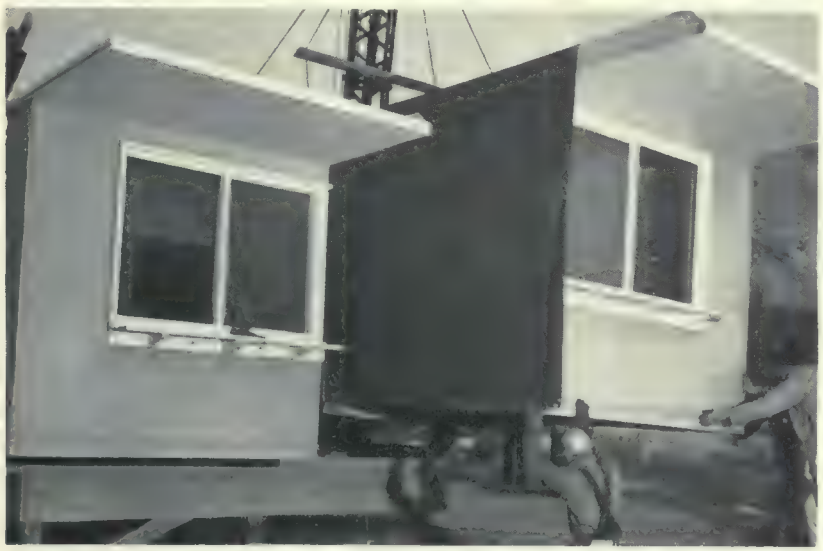
HOUSING SHORTAGE

Photo by Ben G. Glaha, Region II

sion of the Central Valley project in California.

Photo by Harry W. Myers, Region III

Camp Williston barracks from Boulder City now serve as homes for Davis Dam workers.



"Pre-fabs" from Hanford atomic plant will serve as homes for Columbia Basin workers.

the housing problem throughout the reclamation area.

On the Columbia Basin project in Region I, 247 trailer houses were obtained from the Federal Public Housing Authority camps in Kennewick and Pasco, Wash. Fifty were purchased, the remainder leased for the use of veterans and their families. The trailers were trucked to the Government town of Coulee Dam and parked in four camps, one for single men, three for families of Bureau personnel.

Trailers neatly arranged in "streets," with all the necessary facilities available, are used in Region II for Bureau of Reclamation employees at Tracy, Calif. (Delta-Mendota Canal), and Reedley, Calif. (Friant-Kern Canal). Transient agricultural laborers and construction workers live in trailers in Lindsey, Calif.

Region III's housing situation is far from being solved, but trailers furnished partial relief. At Davis Dam the contractor has set aside a special area where privately owned trailers can be parked and connected to all the necessary utilities. In addition, the contractor has 50 units available for rent to veterans only. These trailers were formerly in use at a Navy Depot.

Region IV purchased 23 house trailers. Eleven are in use in the Durango, Colo., area, 4 in the Grand Junction, Colo., area, 4 operating out of Spanish Fork, Utah, and 3 for drill crews at Morgan, Utah.

The Federal Public Housing Authority supplied trailer camps which are now the makeshift abodes of engineers stationed at the Vernal, Utah, field office. Surplus trailers formerly used to house war workers at west coast factories are now used by employees engaged in the program for development of the Missouri Basin project.

In Region VI at the present time 23 trailers are being used. Six are located near the site of Angostura Dam in South Dakota, 12 are housing Bureau employees at the Boysen unit in central Wyoming; 3 are housing field crews engaged on activities relating to the Lower Marias Unit, in northwest Montana; and 2 are being used as living quarters near the site of the proposed Yellowtail Dam, 35 miles south of Hardin, Mont. In addition, Bureau engineers at Region VI headquarters live in trailers.

Salvaged War Surplus Material

If there is an abandoned war surplus camp or building left unwanted, uninhabited and unclaimed in the reclamation area, it is there only because the Bureau hasn't found it yet and worked out some way of using it to beat the housing shortage. At Ephrata, Wash., project officials negotiated with the Army and later with the War Assets Administration, for several hundred buildings which were standing idle at the Ephrata Army Air Base. Some were used on the spot, and others were moved to locations where they were needed and converted to habitable dwellings.

Photo by Joe W. Buller, Region VI

Alexander Burg lives in a tent until he can start building his home at Heart Mountain.

Photo by Joe W. Buller, Region VI

Log cabin homes from the Benbow mines help to alleviate the shortage.

Resident Bureau engineers set up offices in the former headquarters building at the air base. Motor pool buildings, maintenance shops, and about one-half of the base's warehousing facilities were put to use by the Bureau. Hospital wards were converted into apartments for 150 families of Bureau employees. Fifty more apartments were made from former bachelor officer quarters. Two former civilian dormitories were occupied by single men.

The former aircraft shops building was utilized as a Bureau carpenter shop for prefabricating partitions, closets, and other items needed in making living quarters out of buildings never intended as such.

Air base buildings, once used by members of the Women's Army Corps, now house construction crews of a contractor at work on the project irrigation system. An adjacent group of buildings, including dormitories and a former Army mess hall, are being used by another contractor.

Houses which were once occupied by Army and civilian personnel at the Yuma Army Air Base have become the homes of Bureau employees on the Gila project in Arizona. Administrative offices have been established in the former headquarters of the air base on the Yuma Mesa where farms for homestead entry by veterans are being developed.

Twenty-one theater of operation type buildings from the Yucca Army Air Base have been purchased and are being dismantled and transported to Davis Dam. Out of these wartime structures will be erected 20 dwellings, 1 garage and fire station and 1 dormitory and guest house.

As work started on Davis Dam last spring, 10 barracks from the Army's former Camp Williston in Boulder City, Nev., were moved by the Utah Construction Co., down the Colorado River to provide housing for the men who are building Davis Dam. (See *Houses Over the Dam*, back cover, July 1946 ERA.)

From the Hanford atomic energy project, 23 small second-hand prefabricated dwellings went to Coulee Dam. One hundred fifty War Housing Project homes of the 2-, 3-, and 4-bedroom type from Vancouver, Wash., formerly used by war workers, were dismantled and trucked more than 300 miles to Coulee Dam under private contract, where they were reassembled by Government forces. An additional 110 "demountables" have recently been transferred from Vancouver to Coulee Dam to meet the needs of house-hungry veterans and other employees working on the project.

To alleviate the acute housing shortage in Boulder City, Nev., the Bureau of Reclamation in 1942 and early in 1943 constructed 100 portable houses. Many of the lots on which these "temporary" houses were built have been landscaped and are abloom with planted flowers and shrubs.

Fifty additional "temporaries" were acquired from Vancouver, Wash., and sent to Boulder City, Nev., to help solve the still critical housing shortage among Bureau of Reclamation employees in Region III headquarters.

War Relocation Centers

ERA readers are already familiar with the salvaging of buildings and surplus material from former War Relocation Authority centers. (See *The Bureau Reclaims Its Own*, April 1947 issue.) Veterans are already beginning to live on their farm units and to construct their farm buildings from salvaged materials.

At Newell, Calif., one-story barracks originally utilized by War Relocation Authority and Army personnel in the WRA camp at Newell, Calif., will be used to house transient agricultural workers. These barracks will be converted to small apartments on the spot and will not be moved. Others will be torn down and the lumber used for building homes and farm buildings in the area for homesteading veterans on the Tule Lake Division of the Klamath project in California-Oregon.

In Region I, barracks from the Hunt Relocation Center on the Minidoka project in Idaho are already being transported to farms in the area.

Living in a Grain Bin

How would you like to live in a grain bin? The people at Boysen, Wyo., and

Photo by Joe W. Buller, Region VI

Commodity Credit granaries in the first stage of conversion, Boysen, Wyo.

Photo by Greater North Dakota Association Photo (W. F. Schenz)

Joe Paulson's granary house after conversion is the envy of his neighbors.

Photo by Joe W. Buller, Region VI

Kingman twins play in front of their dormer-windowed, storm-doored quonset home.

Photo by Wm. S. Russell, Region III

Pass the ammunition—and build a house, says Navy veteran Walsh.

Terry, Mont., have no objections, and Joseph Paulson of the Lewis and Clark irrigation project in Williston, N. Dak., is the envy of his friends, because of his granary home.

Twelve Commodity Credit Corporation grain bins that helped, in their own way, toward winning the war, are now serving as houses and office buildings in Region VI.

In most cases a single bin is used to fill the desired purpose. However, additions were made to the houses at Boysen out of material salvaged from the WRA Center at Powell, Wyo.

The granaries, 14 feet wide, 24 feet long, and 10 feet high, were constructed in panels bolted together, making it possible to dismantle the structures with a minimum of effort. Each roof, with a 4-foot gable, was in one unit. In order to hold the great weight of the grain, the bins were reinforced on the inside with 2 by 6-, 2 by 8-, and 4 by 4-inch beams, which now serve as main braces for the house structures, making them consideraby stronger than most residences.

Mr. Joseph Paulson, a reclamation farmer on the Lewis and Clark irrigation project, started in the summer of 1946 to build his home, using a commodity credit granary as a basis for building operations. The granary is now the living room 14 by 24 feet, with an open brick fireplace and a large plate glass window. The east wing, housing the bedroom, bath and kitchen-dinette, was added from new material. Mr. Paulson, last January, figured that his grain-bin-home would cost about $3,750.

Buildings used during World War II to house Civilian Public Service assignees (commonly known as "conscientious objectors") are being used as resident buildings for Region VI employees engaged in activities on the Angostura Unit of the Missouri Basin project where construction is now under way. The original camp, located near the site of Deerfield Dam on the Bureau of Reclamation's Rapid Valley project in South Dakota, consisted of 6 temporary cabins, a permanent house, laboratory building, shop, storehouse and two garages. The buildings were dismantled during the early part of 1946 and moved to Hot Springs, S. Dak. Along with additional material salvaged from buildings at the vacated Heart Mountain Relocation Center in northwestern Wyoming, these were merged into a housing project, consisting of 18 two-bedroom, 2 three-bedroom, and 5 duplex resident structures, a concrete testing laboratory and an office building.

Mining Camps

Chromite mining camps where vital supplies were produced during World War II, are being used in Regions IV and VI to fill essential needs in the gigantic construction effort of developing the Colorado and the Missouri Basin projects.

Log cabins and frame buildings, constructed to withstand the rigorous climatic conditions prevailing in the higher altitudes of the Beartooth Mountains, originally used to house workers and administrative personnel engaged in taking chromite from the Benbow Mines near Dean, Mont., are being moved to Billings, Mont., where preference will be given to veterans of World War II employed by the Bureau.

Quonsets

Quonset Huts, named for Quonset Point, R. I., where they were first developed on a wide scale and manufactured for our fighting forces, reappear in many guises on several Bureau of Reclamation projects in the West.

Two hundred of these arched, steel-ribbed huts are being used for various purposes on the Columbia Basin project. The majority have been converted into family dwelling units and men's dormitories. Each of the dwelling units has a 16 by 20 living room, a combination kitchen and dinette, a utility room, two bedrooms, and bath. The Government camps at Coulee City and the Potholes dam site are Quonset villages.

Quonset huts obtained from the War Assets Administration by Region VI are 20 by 100 feet, and, where used for residences, have been divided into duplex apartments.

Photo by Norton T. Novitt, Region VII

At home in a former prisoner of war camp. Youngsters build miniature project while their dads work on Enders Dam.

Photo by Paul E. Norine, Region IV

Home was once like this for the Gillman family. Today it's a chicken house.

Prisoner-of-War Camp

There are a few tell-tale signs at the Bureau's offices in Nebraska which reveal the source of their housing facilities. Floodlights remain on the roofs of some of the buildings, providing street lighting, and reminding the inhabitants that this was a former prisoner-of-war camp, which accommodated 3,000 German POW's. Here and there are reminiscent signboards, some being used by young boys constructing miniature reclamation projects with "spillways" labeled "Military Police." A wartime water tower looks on like a guardian sentinel, as prisoner-of-war barracks are dismantled, reconverted, and parts of the buildings are transported 80 miles from Indianola to Imperial, Nebr., for reassembly into housing, for workers building Enders Dam.

The District Engineer's Office of the Frenchman-Cambridge Unit of the Missouri Valley project, moved right into the area of the former POW camp. Previously, the engineers had been quartered in the Memorial Auditorium at McCook, Nebr. Some of the buildings were remodeled on the spot into apartments and office space for Bureau personnel. Others were dismantled for use as construction material. Former barracks were turned into two buildings to serve as quarters for the Soils Laboratory and the Survey Office.

A 20- by 30-foot section of a barracks building was moved and attached to the garage for office and storage space.

The people at Indianola are not at all depressed by their environment. This spring, employees of the district office could be seen marching en masse to their garden plots, and in April they enjoyed their first all-camp dance and entertainment at the recreation hall of the camp—formerly the POW theater building.

Photo by Lloyd E. Norine, Region IV

Down, but far from out is Mrs. Leroy Nielsen in her comfortable basement residence. The little Nielsens are Robert, Kathleen, and Carol. La Dean and daddy weren't home when this picture was taken.

Ammunition Cases

To Navy veteran Charles H. Walsh, of Logandale, Nev., goes a salute for his method of meeting the housing problem. He built a house of 50-caliber shell cases, on his 10 acres of land near the shores of Lake Mead at Overton, Nev. Mr. and Mrs. Walsh, their children, Susannah, age 5, and Donny, age 2, are now living in their new bungalow, made out of 500 empty ammunition boxes from the Las Vegas Army Air Field—where thousands of aerial gunners had been trained during the war. The house is modern in every respect. Electricity from Hoover Dam furnishes power for domestic needs, and as Walsh said, to a Bureau of Reclamation representative recently, "This is one way of meeting the housing problem. With a couple of coats of paint on the exterior it will serve our needs very well."

CCC Camps

Barracks once used by members of the Civilian Conservation Corps at Palisades, Colo., were converted into six apartment houses at a cost of about $1,200 each, for Region IV engineers and their families.

Area Engineer C. H. Jex, at Grand Junction, Colo., has this to say about the CCC apartments at Palisade: "This office is very proud of the apartments at Palisades and feel they serve a very good purpose in housing of engineer veterans. The families occupying them are very happy with the modern way they have been fixed up and the result is reflected in their work. Also, the nominal rent of $20 a month will enable the Bureau to liquidate the cost of conversion in 3 or 4 years."

Denver "Co-op"

In crowded Denver it appeared that the problem of locating office space had been solved when the Remington Arms plant outside the city limits was declared surplus by the Public Buildings Administration, which assigned part of the plant to the Bureau for use as a Federal center. Converting these factory-type structures into offices presented some difficulties, but the location of the buildings complicated the already critical problems of transportation and housing. To meet the situation a group of 100 employees banded together and purchased 160 acres of land close to the new offices. Some of the reclamation engineers made good use of their professional knowledge to plot home sites. Preliminary work is already well under way on the construction of streets, sidewalks, water and sewage systems, and many other features demanded by a modern community. This is not a temporary wartime or postwar emergency development. The employees have proudly given it a name, Glennon Heights, Inc., and expound the advantages of their cooperative plan which enables the employees to own their own homes, have a gorgeous view of the Rocky Mountains, grow fresh fruits and vegetables in their own gardens, and have space for their children to grow and play.

Another plan—a cooperative employee housing register—resulted in finding homes for approximately 50 Bureau families. Each employee, for 50 cents, could avail himself of the facilities made available, which included display and classified advertising in local and suburban newspapers, spot radio announcements, and a direct-mail campaign to all apartment-house owners and real-estate agencies.

A classic example of cheerfully putting up with abject living conditions until building materials and labor become available is that of the family of John W. Gillman of Orem, Utah, son of James W. Gillman, president of the Provo River Water Users Association. Mr. and Mrs. Gillman and their daughters, 10-year-old twins Karem and Karmen, and 2-year-old Audrey, moved into an ancient, unpainted frame shack in 1942 and lived there until they could start building a modern brick home a year ago. They moved in last fall and are happily looking forward to the 1947 irrigation season on their 40-acre irrigated farm and orchard on the Provo Reservoir Canal, fed by Deer Creek Reservoir. And what of their former "home"? It serves as a brooding house for baby chicks.

Cellar Dwellers

Project farmers in Utah, Nevada, and western Colorado, have for the most part managed during the scarcity of housing materials and labor by "doubling up." In Utah, however, a custom of comparatively long standing, engaged in by thrifty farmers, who believe in "pay as you go," have saved the day for many a family, both nonveteran and veteran. It is the practice of constructing a concrete basement, throwing a temporary roof over it, and living therein, until receipt of the next crop money with which to build the rest of the house. During the housing shortage, couples finding themselves unable to get either materials or labor after getting the basement "poured," lived in the basements as an absolute necessity, and sometimes in rebellion against high cost of materials.

A family quite typical of the "cellar dwellers" are the LeRoy Nielsens' who operate a small irrigated berry farm and orchard on the Provo River project. Situated a few miles north of Provo, on Highway 91, which leads to Salt Lake, their "home," since 1941, has been four basement rooms which they built in the spring of the year and moved into that fall. A spic and span housekeeper, petite Mrs. Nielsen has made the comparatively small quarters more than do for their balanced family of two boys, LaDean 13, Robert 9, and two girls, Carolyn 6 and Kathleen, 19 months. Now, that more building materials are availabe, Mr. Nielsen plans either to complete his home or move to one ready made.

PROGRESSIVE FARMERS MAINTAIN CLEAN FIELDS TO PRODUCE THE GREATEST QUANTITY AND THE BEST QUALITY AT THE LOWEST COST

by J. T. Maletic, *Soil Technologist*
Region VII, Denver, Colo.

WEEDS cost the American farmer an estimated average monetary loss of $450 a year. During the war, weed control was curtailed and the farmer's loss due to weeds increased. Shortages of labor, chemicals, and machinery added to the usual difficulties facing the farmer in controlling the spread of noxious weeds. Controls for preventing the dissemination of weeds in seeds and livestock feed were relaxed. The farmer, under pressure to produce record crops at record speed, could not always be too discreet about the quality of seed and livestock feed. As a result, noxious weeds kept spreading, and the farmer kept losing. Today the shortages and pressures are lessening and a campaign against weeds is on. Introduction of new chemicals, enactment of better State weed laws, a fuller realization of the weed menace, use of new machinery (especially in sugar-beet growing), and the increasing interest of farmers in weed control are resulting in a vigorous postwar fight against weeds.

The Bureau of Reclamation's sound movie, *Fighting Weeds*, will aid the farmer in planning his battle against weeds. This film covers many known practices of weed control that have been proved practical. As yet information covering the use of 2, 4–D is not included; however, as this chemical and other new methods take their place among other proven control practices, new footage will be added. The film is directed primarily to the irrigation farmer; however, it is also an excellent film for the dry-land farmer located on future project areas. Here is the story of weed identification, prevention and eradication as told by this film.

Identification

You have to know your weeds before you can know how to control and eradicate them properly. Weeds are classified according to length of life, as follows: Annuals, biennials, and perennials.

ANNUALS are plants which start from seed in the spring, summer, or early fall, and complete their entire life cycle in 1 year. They usualy have a small root system and produce an abundant crop of seeds, some of which retain their ability to germinate for several years. Common weeds in this group are Russian thistle and sunflower.

BIENNIALS are plants which complete their life cycle in 2 years. These plants produce only roots and leaves the first year but build up a large reserve food supply. The second year they produce flowers and seeds. Burdock, mullen, white, and yellow sweet clovers, and wild carrot belong to this group.

PERENNIALS are plants which live three or more years. They are subdivided into simple and creeping perennials. Simple perennials reproduce only by means of seeds. They generally have large tap roots such as curled dock and dandelion but may have fibrous roots, like Rugel's plantain. Creeping perennials reproduce by creeping rootstocks or underground stems, as well as seeds. Some of the most troublesome weeds belong to this group; for example, field bindweed, Canada thistle, white top, Russian knapweed, and leafy spurge. The film advises, "When in doubt about the type of weed, consult the county agent; and never initiate a control or eradication program until the weeds are properly identified."

Prevention

To start an effective program of preventing weed growth, get at the source of weed seeds. Some means by which weed seeds are spread, include:

1. Crop seed.
2. Wind.
3. Streams and irrigation distribution systems.
4. Domestic and wild animals.
5. Farm equipment, and other vehicles.
6. Screenings, forage, and other feeds for livestock.
7. Persons' clothing.
8. Moving livestock from weed-infested areas.

Once you know where the weeds come from, active steps can be taken to prevent weed seed dissemination. You can (1) plant only certified weed-free seed; (2) mow or burn weeds in the bud stage; (3) control perennial weeds; (4) establish grasses and other weed competing plants on ditch banks (just as you would prepare a pasture); (5) use cattle guards if ditchbanks are used for pasture; (6) increase ditchbank pasturing and reduce operations costs by removing willow and other weed growth; (7) avoid over-grazing ditchbank pastures; (8) clean weed seeds from clothing before leaving infested fields; (9) clean weed seeds from thrashing and other farm equipment before entering clean fields; (10) grind screenings finely before feeding, and (11) hold cattle in corrals several days before transferring them to clean areas.

Department of Agriculture photo
Man-size Russian knapweed in orchard.

Eradication

The best methods of controlling weeds will vary for different areas due to differences in soil texture, soil fertility, water table, climate, etc. Frequent cultivations known as "clean cultivation," or shoot-cutting at regular intervals, usually about every three weeks, is the most economical control for some weed patches. For some weeds, such as field bindweed, cultivation will have to be continued over a period of 2 or 3 years. The choice of the implement depends upon the size of the infested area but the cutting blades used should overlap sufficiently to prevent skipping any of the weed shoots. If the patches are too large, or whole fields are infested, and you find you cannot afford to cultivate them, plant a smother crop, or winter grain, and, keep the crop in good growing condition. If grain or other early maturing crop is planted, shootcutting should be practiced for the remainder of the growing season after harvesting the crop.

For small patches, where it is impracticable to use the cultivation method, chemicals may be employed. Sodium chlorate is the cheapest chemical to use in some instances, particularly noncultivated areas, but it must be remembered that it may sterilize the soil for several years. Caution must be exercised in using chlorate due to its highly inflammable nature. Make applications in the fall to take advantage of the winter rains. In general, sodium chlorate is applied at the rate of 5 to 7 pounds per square rod. For small patches of weeds, carbon bisulphide has been found to be very effective and, while it is more expensive, it does not sterilize the soil. It is recommended that a weed gun built for the purpose be used, and that 2 ounces of the chemical be injected into the soil at 18-inch intervals. It should be applied at a depth of from 4 to 6 inches depending on the type of soil and other factors.

Weeds spread like an epidemic disease. Like a disease, an ounce of prevention is worth a pound of cure. Weed surveys are showing that weeds are taking over more and more territory. The area of infested land is definitely increasing. To help farmers combine their weed-control efforts, many of the States have enacted weed laws that provide for the formation of weed districts. District organization assures a district-wide eradication program. Under district organization, weed control is conducted on farm land, roads, railroad right-of-ways, ditches, and other areas within the weed district. The method of financing weed control district programs varies with individual States.

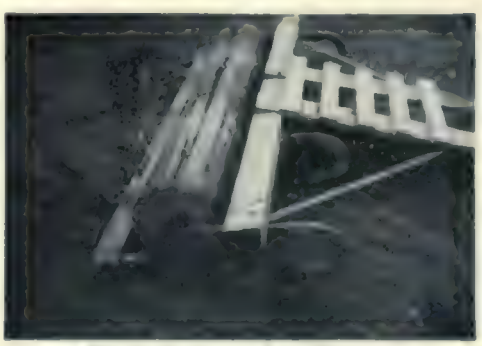
The film, Fighting Weeds, upon which this article is based, was produced by the Branch of Operation and Maintenance of the Bureau of Reclamation in cooperation with State Agricultural Experiment Stations and Federal agencies. Copies of film are available upon request to the Regional Directors, Bureau of Reclamation, at Boise, Idaho, Sacramento, Calif.; Boulder City, Nev.; Salt Lake City, Utah; Amarillo, Tex.; Billings, Mont., or Denver, Colo.

Bindweed. . . .

reaching a railroad right-of-way.

White top spreading from roadside. . . .

and infesting a farm.



Single blade weed eradicator.

International Engineering

Australia—

Mr. Ian Langlands, Officer in Charge of the Building Materials Research Section of the Australian Council for Scientific and Industrial Research, recently completed arrangements while in the Denver office for having a student research member of his staff take a course in practical training in that office. Mr. Langlands, who has returned to Australia, will name the student in the near future who will receive several months training in the concrete research laboratory.

China—

Eight Chinese engineers recently reported to the Denver, Colo., office for assignment to the sections planning the important Yangtze Valley project. The men were made available by the Chinese Government, all being qualified graduate engineers with some experience. The Yangtze Gorge is the project for which internationally known Dr. John L. Savage, formerly the Bureau's Chief Designing Engineer, drew up the preliminary plans under the auspices of the State Department at the request of the Chinese Government.

Egypt—

Mr. S. O. Harper, former Chief Engineer of the Bureau of Reclamation, has recently returned from Egypt where he has been serving as a consultant to that government in connection with the proposed raising of the Aswan Dam on the Nile River. His services were obtained through the United States Department of State. In addition to this major assignment, he also advised the Egyptian Government on over-all resource development of the Nile.

Robert Brown Goes to China

Robert C. Brown, former Region V Bureau engineer on the San Luis Valley project in Colorado, has joined the program planning staff of UNRRA on the Yellow River project in China. His headquarters are in Shanghai, but he will work in the downstream area of the Yellow River, which will be diverted to relieve two million acres of land suffering from periodic floods.

The work is being done under the Ministry of Agriculture and Forestry in the Nationalist Government with UNRRA serving as a consultant. Brown is acting as a technical adviser and will engage a staff of Chinese engineers. He expects to remain abroad until September 1947.

He has been with the Bureau since 1938, having started as a transit man on the Vallecito Dam in Colorado. From there he went to San Luis Valley where he spent 5 years as an engineer. Prior to becoming associated with the Bureau, Brown spent 4 years with the New Mexico State Highway Department.

Retiring on the Run

or

90 Years Without Settling Down

by Orin Cassmore,

Sacramento, Calif., Region II

Doing stories on people retiring used to be easy. Each one was just like the one before it, with only the names changed. Clichés snapped into line with as little fuss as troops at a separation center—the Job Well Done, the Race Well Run, The Old Warhorse turned out to Graze in a Pleasant, Daisy-speckled Pasture.

Nowadays, it's not so easy to write about people retiring. We found that out when we started to interview Gilbert H. Hogue and Lewis E. Foster of Region II, who have been with the Bureau for 45 years (ever since it started, and before) and are now leaving after lending us several extra years of their time during the war.

Today's retiree is fast on his feet. Before you can write about him, you have to catch him—no small job, as we found on a visit to Gilbert Hogue's retirement party at Friant Dam.

After a fine speech by Assistant Regional Director Bob Calland, who had been pointing out the exceptional moral values that make up for the modest salaries in long careers of public service, Mr. Hogue rose to his lean height and said with simple dignity: "So long, slaves," reached for his overcoat, and was off to Mexico with his wife.

Lewis Foster, who'd shifted to Sacramento from his 1912–45 superintendency of the Carlsbad project to pinch-hit for us during the personnel shortage, looked like a better bet. We found him settled back in a comfortable armchair beside a glowing fire in a long and lovely room, one of several such in a rambling cement-block home with a patio full of citrus and exotics, a home straight out of a sunset treatise on "Western Living." This looked like the real stuff for an old-style retirement article. Except for one discordant note—sticking impudently into the lawn was a sign—"For Sale."

Despite his ease, Mr. Foster looked a little gloomy and restless. "Not that I'm not glad to see you, but when I heard you drive up, I thought you were somebody come to buy the house."

Mrs. Foster, filled with vitality and humor, and a disturbing charm which seems hardly proper in a person married shortly after the Spanish-American War, a lady whose eldest son is graying distinctively at the temples, added, "Yes, Lew is anxious to get going."

Get going where? And ***why?*** Southern California, they replied, where kinfolk live, where they ***may*** decide to retire for good on a few acres where Mr. Foster can experiment with citrus, or more probably, establish a base for the trips they've wanted to take for the past 40 years.

This restlessness was disappointing, for it once again ruled out that typical old retirement piece. But at least the Fosters would be there long enough for us to get ***some*** kind of a story. Since it was too late in the day for prospective buyers and they couldn't get away until they ***had*** sold the house, the Fosters were able to relax for a while and brief us on 45 years with the Bureau of Reclamation.

Photo by J. E. Fluharty, Region II

Hogue is "given a ticket" before he starts for the open road.

Mostly, Mr. Foster wanted to talk about the many great guys he had known in the Bureau, and what ***they*** had done. "Yes, there was always the feeling that we had a great mission; and there always seemed to be great men to carry it out." He told of F. H. Newell, first Reclamation Commissioner, and his vision of what the Bureau could accomplish by helping the West prosper through a sturdy democratic ecomomy of family sized farms; of Engineer Louis C. Hill, whose work made Salt River, Rio Grande, Carlsbad, Yuma, and other projects possible; of Chief Engineer F. E. Weymouth and the able men who followed them.

But we wanted ***Mr. Foster*** as the subject of the story, not only because his tour of duty more than covered the life-span of the Bureau of Reclamation and the Reclamation Service before it, but even more because he had been actively connected with one single project—the Carlsbad—almost all that time. He had been down where the work is, down where the big plans and high policies either pan out or peter out. So he began by telling us that he was born near Los Angeles, Calif., on the small, diversified farm (some fruit, some alfalfa, some Morgan horses and Hambletonians) that his father purchased shortly after he came out from Maine in 1875. In 1898, he went off to the Spanish-American War.

Out of the service, he joined the Hydrographic Branch of the Geological Survey, granddaddy of the Bureau of Reclamation, at Montrose, Colo. Transferring to the Reclamation Service, when it was set up in 1902, he worked as rodman, topographer, hydrographer, and instrument man on some of the first surveys, including those of the famous Gunnison Tunnel on Colorado's Uncompahgre project.

Early in 1907 he was appointed superintendent of irrigation for the Carlsbad and Hondo projects in New Mexico, and immediately married Claire Waltz of Berkeley, daughter of a minister who had homesteaded up in the Coeur d'Alene country back in the late Seventies—the girl he'd met and fallen in love with 9 years before.

"They only let me have 2 days off to get married," he stated, adding that this was an indication that the Government was very busy getting water on the land of the Carlsbad-Hondo projects. From Mr. Foster's remarks, we gathered that he had been appointed as superintendent of irrigation to see if he could figure out some way to get back the good money that had gone sailing after bad, down the Pecos River. Mr. Foster said, cautiously, "It might have been better, at the time, if we hadn't gone in there." That puts it mildly.

In the first place, said Mr. Foster, the water supply was meager and poor. There were 4 tons of solids—gypsum and salts—per acre-foot.

In the second place, much of the land was not good. About 3,000 to 4,000 of the project's 25,000 acres were (and are) marginal. Because of poor drainage, they were only suitable for farming during 2 years out of every 4.

In the third place, no one could predict when spring would come, and frost bit deep into the growing season.

In the fourth place, where in the world did the original settlers expect to sell the stuff they planned to raise?

"You can add to that," said Mr. Foster, "occasional rampages by the river (as late

as 1940, a million-acre-feet went down a stream that normally carries but 250–300,000 a year). And a leaky reservoir. ***And*** inexperienced farmers. The Pecos Valley Investment Co. was composed of promoters from the rain belt, nonfarmers from the East. They all came tearing blithely West in 1888 looking for a good place to try out this irrigated farming idea that could make men rich overnight. Knowing nothing whatever about it, they picked a stretch of country that looked wonderful only because it was having one of its rare good water years. By 1893 they had McMillan and Avalon Dams built. By 1904, almost everyone and everything was busted, including Avalon Dam."

Mr. Foster then went on to explain how a call for help to the Federal Government was answered in 1904—principally, it seemed, because of Theodore Roosevelt's fanatic belief in the ability of his reclamation program to take any hurdle, no matter how high.

Everyone had to get busy fast, patching and planning and advising and educating, to meet one of the new Reclamation Service's first great tests, that of putting this exceedingly shaky project on its feet. The engineers rebuilt Avalon Dam and designed spillways for both dams (which the first builders had neglected to do) in order to ease the dangerous pressures that came with every flood. An intelligently planned drainage and distribution system was laid out after careful investigation had showed just what was wrong with the area. "Part of it was underlaid with gypsite deposited through the years until it formed an impervious hardpan which caused the affected area to fill up like a saucer after a few irrigation seasons," explained Mr. Foster.

Cooperation of the State Agricultural College was enlisted to set up demonstration farms and determine what crops were best suited for the project. It had raised wonderful peaches, but spring frosts too often took the fruit buds. Sugar beets had looked like a good crop, but careful study indicated that local pests made them another unsuitable investment. So cotton was pushed as the main crop, for it was hardy, pest-free here, and could be stored indefinitely or ride a thousand miles to market without loss. The demonstration plots worked out the most conservative rotation for the area—cotton, small grain, alfalfa, and cotton.

By 1914, the project's horizon had brightened. "If a farmer came in and did not buy so much land that his working capital and reserves were impaired, he could pretty well count on making a go of it," Foster stated. "One genuine evil, hard to conquer, had been high-pressure selling methods by the development companies, into whose hands fell much of the acreage the first settlers abandoned. Almost two sets of farmers had been plowed under since 1888, but it looked like the third would make it."

Well, they did. Project management kept learning more and more about the country and the land. Crop patterns, cultivation, and irrigation practices that would make best use of the gypsum soils and mineral water supply, were worked out. Cooperation with the college continued and expanded.

"There were always studies and experiments going on, covering what should be grown and how to grow it. The behavior of the land under irrigation was carefully checked, and the staff soon knew exactly how every acre would react. A system of shifting water rights around to make fullest use of land that could produce for a short while, then had to drain for a year or two, was worked out. With constant care and watchfulness, Carlsbad became a stable productive project. We really had to work, but we finally got the project so it could pay off," said Mr. Foster. "Most of the credit for this goes to the fine group of intelligent, hard-working, cooperative farmers, who took the bad years with the good, learning something from each failure. The project is now, without a doubt, successful."

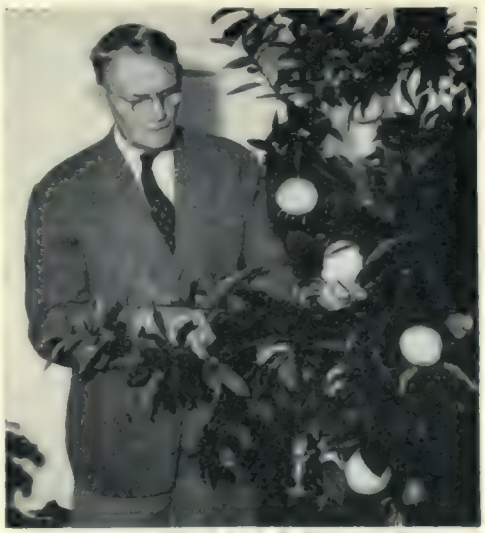


Photo by J. E. Flaharty, Region II

Foster's hobby from now on.

"At what cost?" we asked.

"Original work on the dams and canal systems cost the people of the United States $1,400,000, now practically all paid back," Foster replied proudly.

"A third dam, Alamogordo, an incredible 200 miles farther up the Pecos, proved necessary because the river's enormous silt load was choking the lower dams. This dam and some concrete canal lining will cost another $2,600,000. The water users started repayment on these final features last year with far better prospects of unbroken repayment than they had for repayment of half that amount 40 years ago.

"Operation and maintenance charges run around $2 to $2.50 per acre," he continued. "By the way, the project started out with a staff of a superintendent, a hydrographer, a chief clerk, and one or two other clerks, a watermaster, a foreman, and a few laborers, and remains just about the same."

Although Mr. Foster didn't say so, we know that in return for this outlay, a hopeless barren, once a failure, has been turned into a region that regularly produces crops worth $85–$100 an acre, with all that this means to the farmers, to the towns in the vicinity, to people far away who make the things these farmers buy. And the farmers buy plenty! They are ***very*** prosperous now, and have been moderately so for a good many years.

But Mr. Foster ***did*** say that this prosperity has been achieved on farms averaging less than 100 acres. "A 160-acre farm is enough for a ***real*** farmer; a man who likes to farm. Our people do well. Not just a meager, careful living—every winter, lots of them drive their good cars out to warmer places for a vacation. It's about all any sane man would want."

"All these years, how did events in the world outside, changing policies within the Bureau and the Department, affect the work at Carlsbad?" we queried.

"Well, within the Bureau, there was always a magnificent spirit—men that would stand by you 100 percent in spite of frequent hell, and high or low water. There were some bad times from administrative changes. Some were irritating, but amusing—like the infinite variety of questionnaires one Secretary sent out, including one demanding a full description of 'All types of steam vessels operating on the reservoirs under your control.' Some were not so funny," he said wryly.

The trend in the last few years has been good, in the main, Mr. Foster thinks. Particularly as the Bureau has recognized nationally what was obvious early in the history of the Calsbad project: that our work does not end when the dams are built, and the water comes down through the distribution systems.

"If projects are to pay out, if farmers aren't to be plowed under, there must be constant scientific and practical study of changing problems—water use, crop and cultivation and fertilization practices, shifts in consumer demand. This will be done with the full cooperation of research agencies and county agents. But each region needs its own staff to collect and adjust findings of these other agencies to the use of reclamation projects. And, above all, each project needs somebody who is passionately interested in reclamation from the farmer's point of view, not merely as an administrator and collector of water charges, to bring these findings right down to every acre on his project. Even after a project is on its own, it needs someone to do the same kind of a job," Mr. Foster stated.

The great lesson he learned at Carlsbad is that "Irrigated lands will always turn up with new problems—of soil, of water, of changing economic conditions. Reclamation is a job that never ends."

Were the Fosters sorry that the job was over, sorry to leave a place where they'd

(Continued on page 142)

Brahman Cattle

(*Continued from page 131*)

velop for market, and their ability to forage on poor range.

Brahmans vary in color; some are white, others are silvery gray, steel gray, and dark gray. Dark hips and shoulders appear to predominate in the bulls. The eyes are mild—sleepy appearing, and the ears are broad, long, and pendulous. The neck is short, and it blends smoothly into a well-fleshed shoulder. The hump, which is directly above the shoulders, is large in bulls, but not so highly developed in cows. The ribs are well sprung and evenly fleshed, and the depth of the body compares favorably with the width. The hindquarters show an abundance of flesh, which extends down on the hind leg near the hock.

Stamina Unlimited

Some Brahman breeders and range men believe the hump stores energy for the animals' use when hard times come knockin' at the door, somewhat as the hump, which it is said, enables the camel to go days without water. Brahman owners say the hump grows and recedes in tempo with adequate or inadequate feed. It is a fact that Brahmans can and do travel farther for water and grass than any other type of cattle.

Brahmans have massive bodies, deep and thick. Their bone is large, but not coarse. The average cow, in good condition, will weigh from 1,000 to 1,200 pounds, and the bulls range from 1,700 to 1,900 pounds. Cows fed for the show rings weigh up to 1,700 pounds; whereas, the bulls often attain a weight above 2,200 pounds.

A surprising characteristic of the Brahman cattle is that they sweat. This phenomenon is observed principally on the neck and in the creases of the hide covering the shoulder vein and dewlap where the perspiration oozes through the skin. Another interesting feature about Brahmans is the fact that they never open their mouths and pant.

The first Brahmans, a bull and a cow, were brought to the United States in 1849, by James Bolton Davis of Fairfield County, S. C., while serving as ambassador to Turkey. The records of these cattle were lost during the War Between the States.

The second importation of Brahmans to this country was in 1854. Richard Barrow, a Louisiana plantation owner, had entertained and assisted a representative of the British Government, who had been sent to this country to study sugar cane and cotton production. The plantation owner refused payment for his assistance to the British official, but the British Government, not to be outdone in good neighboring, proceeded to ship four Brahman bulls from India to the Louisiana planter.

Word of the Brahman bulls and their offspring spread to Texas, and Lone Star State ranchers rode over to the Barrow plantation to check first-hand on the wild rumors about the strange critters. The Texans learned that Brahmans were large and energetic, and that they would graze greater distances from water, and feed over more acres than the famous Texas Longhorns, then being grown in the Gulf coastal area and in the Lower Rio Grande Valley. The Texans became the leading customers of Louisiana Brahman breeders, and they bought and sold and raised a great many in the seventies and eighties.

In 1855, J. M. Frost and Albert Montgomery of Fort Bend County, Tex., near Houston, purchased two Brahman bulls in India. These bulls were mated to cows carrying some of the blood of the four Louisiana plantation bulls, which strengthened the bloodlines of the breed on the American continent.

Some of the Louisiana Brahmans were driven to Texas in 1889, and J. D. Hudgins, of Hungerford, Tex., purchased a dozen of the top animals to begin a breeding herd that has become famous in this country. Today, Edgar H. Hudgins, of the J. D. Hudgins Estate, ranks among the foremost breeders and authorities of Brahman cattle. Mrs. S. C. Broder, secretary of the American Brahman Breeders Association, maintains offices at Hungerford. The association's office, however, will be moved soon to Houston, Tex. Numerous importations of Brahmans were made from India in the following years until now the breed is prominent throughout the South and several of the arid Western States where natural conditions make for hardship on men and beast alike. The Brahmans are inherently and physically fitted to withstand the southern and droughty elements.

The Cattleman's Choice

R. P. Guerra, McAllen, Tex., business leader and active proponent of the Bureau of Reclamation project that is designed to supply water to approximately 700,000 acres of the Rio Grande Valley's citrus groves and winter vegetable gardens, is one of the leading breeders of Brahmans along the United States-Mexican border. Mr. Guerra comes by his love of livestock through generations of cattlemen dating back to the time of the Conquistadores. The Guerras have been engaged in the livestock industry along the Lower Rio Grande since 1740. There they lived, worked, served in war, and prospered under the colors of five republics.

The Brahmans now being bred and ranged on the 32,000-acre Guerra ranch in the Rio Grande Valley are the result of an intensive search for a breed of cattle that would thrive best in the heat and among the Texas fever ticks, insects and ailments common to the Texas-Mexican border. The famed Texas Longhorns had been replaced by breeds that produced more beef, but which failed to prosper in the area.

The American Brahman Breeders Association claims that "Brahman Cattle Always Lead—Never Trail." Mr. Guerra relates interesting experiences in this country and in Old Mexico to prove that Brahmans, on the trail with any other breed of cattle, can outwalk and outlast all others. Brahmans have developed characteristics which enable them to preserve and perpetuate their life where most other cattle become prey to heat, drought, disease, and other pestilence.

Most of the 5,000 head of cattle on the 73,000-acre ranch of Elmer and Lloyd Bentsen, 40 miles northwest of McAllen, are Brahmans. The Bentsens prefer them to other breeds on the basis of profit, coupled with the ease with which they are produced in the arid region.

J. E. Pate and son, J. W. Pate, are among the numerous Lower Rio Grande Valley breeders and importers of Brahman cattle. They irrigate their pastures at Hidalgo, Tex., just across the international bridge from Reynosa, Mexico, with waters from the Rio Grande, and the Pate cattle have to do less rustling for their feed than their kin, who range among the thorns of the brush in other areas of the Southwest. The Pates have special pride in the quiet behavior of their cattle, and treat them with unusual kindness.

Many Texas breeders now import choice animals from Brazil, where the Indo-Brazil crossbreds are quite common.

J. D. Hudgins, whose heifer calf, Queen Resoto Manso 153, was champion of the Houston Fat Stock Show in 1946 and repeated championship honors of the class at the 1947 exposition, says the Brahman crossbred cow is a much better mother than the average range cow. They have an unlimited amount of energy, and are great rustlers. They are usually in fine condition, and they give plenty of milk that contains a higher percent of butter fat than that of the British breeds and slightly higher than that of the Jersey. Butter fat in Brahman milk has been recorded as high as 7.7 percent, according to Mr. Hudgins.

Brahmans, in a comparatively short time, have become the choice of cattlemen in most sections of the country where heat and drought and many related troubles have routed other breeds. They are being boosted by the breeders and ranchers through an association that was organized less than 25 years ago. The association is incorporated under the laws of Texas, and sanctioned by the United States Department of Agriculture, for the purpose of registering worthy individuals of the Brahman breed. No record association has ever used more care to enter only worthy animals in the registry.

It is unfortunate that most Americans have been introduced to the Brahman cattle only in rodeos, where they react to such beastly treatment by becoming vicious. But the men, women and children who raise, feed and care for them know that they respond to kindliness with wistful trust. They have changed the old saying to: "as **mild** as a Brahman steer."

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

2. *The Colorado River.*—Comprehensive departmental report on development of water resources of Colorado River Basin for review prior to submission to the Congress. Limited number of copies available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

3. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, 7-page mimeographed study with graphs.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *High-Pressure Reservoir Outlets,* by J. M. Gaylord and J. L. Savage—a report (1923) on Bureau installations compiled from correspondence, project histories, feature reports, technical papers, special reports prepared for this purpose, and from personal inspection of the installations described. Obtainable from the Superintendent of Documents.

2. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

3. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest release is: Standards and Levels of Living, studies by the Department of Agriculture for Problem 9—20 cents.

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 24, Agricultural Processing Industries—30 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

4. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Table showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

5. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

Miscellaneous Publications

Soil Properties Contributing to Citrus Chlorosis as Revealed by Seedling Tests, by W. T. McGeorge, agricultural chemist, Department of Agricultural Chemistry and Soils, Agricultural Experiment Station, College of Agriculture, University of Arizona, Tucson, Ariz.; 165 pages with illustrations, Technical Bulletin No. 112, September 1946. A study designed to determine the manner in which the alkaline-calcareous characteristic contributes to micro-nutrient element deficiency symptoms in Arizona soils.

The Electric Light and Power Wage Structure, by Joseph W. Bloch, economist, United States Bureau of Labor Statistics, in *Public Utilities Fortnightly,* January 30, 1947, page 143. Comprehensive survey of the types of employment of the nearly 200,000 workers in the privately owned industry, and an analysis of payments for the varied classes of service.

More and Better Forage on Irrigated Pastures, by Curtis R. Fuller, in *Western States Reclamation Journal,* February 28, 1947, page 10. Illustrated. Livestock operators on irrigated farms and ranches can make large contributions to the food producing effort by improving their management of pastures already in use and by establishing new ones.

Shall We Spend $2,000,000,000 More on the Colorado? by Edward Churchill, in the *Saturday Evening Post,* February 22, 1947, page 28. Illustrated. The author discusses the question as to whether the muddy, erratic Colorado River—even with projects vaster than Hoover Dam—could possibly provide jobs, crops, and baths for the millions of thirsty people who look to the river as their life line.

Frank Banks—Wilderness Fighter, by Don Eddy, in *This Week,* March 16, 1947, page 4. Illustrated. The dramatic story of a shy New Englander who for 40 years has battled blizzards, floods, and grizzlies to make the Western wastelands bloom. (Copies of *This Week*—syndicated weekly magazine supplement—are obtainable by writing to United Newspapers Magazine Corp., Publishers, 420 Lexington Ave., New York, N. Y.)

Engineering Publications

Available from the Design and Construction Technical Library, Bureau of Reclamation Customhouse, Denver, Colo.

1. *New Results in the Determination of Foundation Properties by the Dynamic Test Method,* by H. Lorenz.—Translation by the Bureau of Technical Library from VDI Zeitchr (1934), of article on apparatus and research of dynamic testing of soils and foundations. It was found that with a surface vibrator, it was possible to identify various strata and estimate their bearing power.

2. *Experimental Attempt to Solve the Problems of Failure in Nonmetallic Materials,* by M. Ros and A. Eichinger.—Translation of Report No. 28 of the Swiss Federal Materials Testing Institute by the Bureau Technical Library. The various failure theories are reviewed and from the interpretation of the test results obtained on different materials, the conclusion is reached that a general failure theory is not possible, since the structural composition differs among materials themselves.

3. *New Protection Against Airborne Diseases*—published by Lustra Corp. of America. This booklet gives complete details of five new models of germicidal fixtures. There are many practical applications for farm use.

U. S. GOVERNMENT PRINTING OFFICE: 1947

Notes for Contractors

Contracts Awarded During April 1947

Specification No.	Project	Date of award	Description of work or material	Contractor's name and address	Contract amount
1358	Mancos, Colorado	Apr. 17	Construction Jackson Gulch dam and inlet and outlet canals.	Vinnell Co., Inc., Alhambra, Calif.	$1,925,904.50
1585	Colorado-Big Thompson, Colorado.	Apr. 11	Schedule 2, construction Granby pump canal	do	591,358.75
1645	Davis Dam, Arizona-Nevada.	Apr. 16	One 325-ton gantry crane, one lifting beam	Star Iron & Steel Co., Tacoma, Wash.	306,300.00
1666	Klamath-Tule Lake, California.	Apr. 18	Construction earthwork and structures, M Canal, Station 127+01 to 143+30, Modoc Unit.	George R. Stacy, Tule Lake, Calif.	120,341.00
1667	Central Valley, California	Apr. 16	Construction Shasta Dam to Summit City highway, and Shasta Dam left abutment parking area.	Harms Bros., Sacramento, Calif.	814,273.50
1671	Missouri Basin, Hardin, Mont.	Apr. 21	Schedules 4 and 8, exploration tunnels, Yellowtail damsite.	Jayhawk Construction Co., Billings, Mont.	119,546.00
1672	Yakima-Roza, Washington	Apr. 11	Construction lateral distribution systems of pump areas 1 and 9.	Morrison-Knudsen Co., Inc., Boise, Idaho	135,029.00
1675	Central Valley, California	Apr. 2	Items 3 and 4, fabricated and standard pipe, pipe fittings, bolts, gaskets, for 96-inch river outlet gates, Shasta Dam.	Associated Piping & Engineering Co., Inc., Compton, Calif.	10,283.00
1683	Columbia Basin, Washington.	Apr. 25	7 vertical-shaft pumping units for 6 relift pumping plants. Pasco lateral system.	Food Machinery Corp., Peerless Pump Division, Los Angeles, Calif.	26,127.10
1687	Central Valley, California	do	Hollow metal doors for control bay and service bay units 2 and 5, for Shasta Power Plant.	M. Reuter & Sons, Portland, Oregon	12,375.00
1689	Columbia Basin, Washington.	do	Hollow metal doors for elevator towers and power plant; steel partitions with doors for left powerplant, Grand Coulee Dam.	do	34,928.00
1693	Central Valley, California	Apr. 16	Construction Contra Costa Canal, Stations 1993+11 to 2321+25, and Clayton and Ygnacio Canals.	Parish Bros., Benicia, Calif.	1,072,147.50
1695	Boulder Canyon, California-Nevada-Arizona.	do	Aluminum railings, door frames, curbs and trim; metal partitions; steel doors and stairs; structural and architectural metalwork, for Boulder power plant.	Neuman Bros., Inc., Cincinnati, Ohio	36,737.00
1703	Yakima-Roza, Washington	Apr. 15	Steel pipe and accessories for wasteway crossing, Wasteway No. 5, Stations 162+78 to 539+00, and for lateral distribution systems.	American Pipe & Construction Co., Portland, Oreg	11,050.00
1708	Central Valley, California	Apr. 18	Furnishing and installing sheet-metal ducts for ventilating system, Shasta power plant.	Fox Metal Products Corp., Ogden, Utah	19,666.00
RV-1	Rio Grande, New Mexico	Apr. 25	Reconstruction of Elephant Butte roads	Jones Bros., Albuquerque, N. Mex.	47,643.00
2213	Columbia Basin, Washington.	Apr. 10	900,000 square feet of plywood	Rucker Bros. Lumber Co., Ephrata, Wash.	111,132.00
7475-A	Davis Dam, Arizona-Nevada.	Apr. 18	Poles for 161-kilovolt line	J. H. Baxter & Co., San Francisco, Calif.	246,798.10
G-38,236-A	Columbia Basin, Washington.	Apr. 10	110,000 barrels portland cement	Spokane Portland Cement Co., Spokane, Wash.	391,776.00
67,020-A	Missouri Basin-Enders Dam, Nebraska.	Apr. 23	1,710,481 pounds reinforcing bars	Capitol Steel & Iron Co., Oklahoma City, Okla.	97,428.76

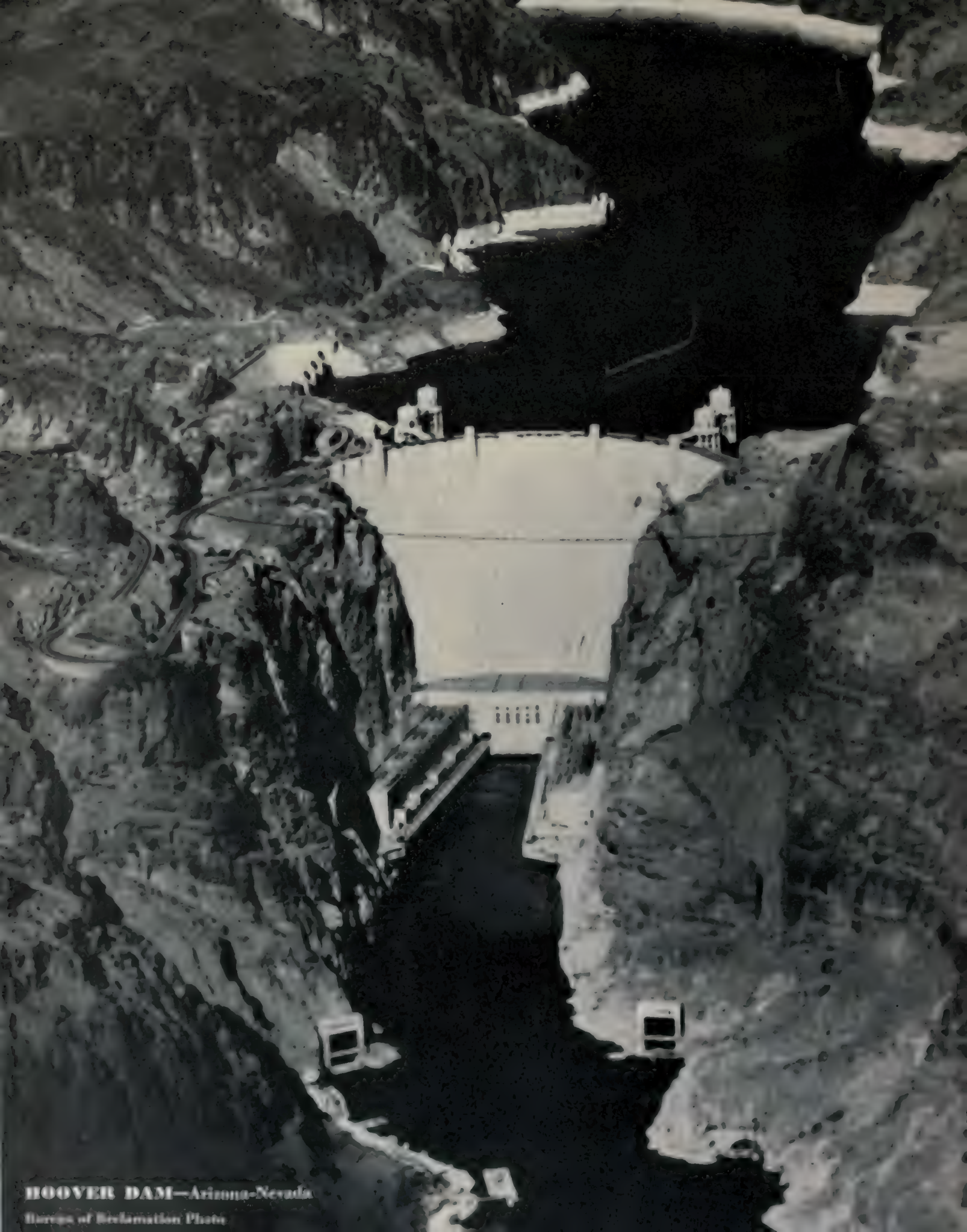
Construction and Supplies for Which Bids Will Be Requested During June 1947

Project	Description of work or material	Estimated date bids to be invited [1]	Estimated bid opening date [1]
Boise, Idaho	Butterfly valve for Anderson Ranch Dam and power plant	June 1	July 7
Central Valley, Calif.	Pump discharge pipes for Tracy pumping plant	do	Do.
Do	Utilities for Tracy government camp	do	Do.
Do	Materials for Shasta-Tracy 230-kilovolt transmission line (88 miles)	do	Do.
Davis Dam, Nevada-Arizona	Control board for Phoenix substation	do	Do.
Do	Miscellaneous steel and cast iron pipe for Davis power plant	June 2	July 8
Boise-Payette, Idaho	Earthwork and structures, "C" Line West laterals 1.6 to 23.5	June 6	July 11
Central Valley, Calif.	Butterfly valve for Tracy pumping plant	June 15	July 21
Colorado-Big Thompson, Colo.	Siphon No. 1 for Horsetooth Feeder Canal	do	Do.
Do	Control and station service distribution boards for Estes power plant	do	Do.
Do	Unit substation and pump boards for Granby pumping plant	do	Do.
Do	Control and station service distribution boards and station service transformers for Marys Lake power plant	do	Do.
Do	Materials for Sterling-Sidney 115-kilovolt transmission line (40 miles)	do	Do.
Columbia Basin, Washington	Insulators for 230-kilovolt right switchyard, Grand Coulee power plant	do	Do.
Do	Conductors for generator circuits R-1, R-2, R-3, tie circuits 1 and 3, 230-kilovolt right switchyard, Grand Coulee power plant.	do	Do.
Davis Dam, Nevada-Arizona	Power transformers, oil circuit breakers, disconnecting switches for Parker power plant	do	Do.
Do	Crossarms, conductor and conductor hardware for the Tucson-Cochise transmission line	do	Do.
Do	Conductor and conductor hardware for the Parker-Davis transmission line	do	Do.
Parker Dam, Arizona	Oil circuit breakers, disconnecting switches, instrument transformers for Gila, Ariz.	do	Do.
Provo River, Utah	Siphon, penstock and discharge lines for Jordan Narrows pumping plant and siphons	do	Do.
Davis Dam, Nevada-Arizona	Air compressors and associated equipment for Davis power plant	June 17	July 22
Central Valley, California	Earthwork, pipelines, and structures for laterals 4.8, 5.3, 5.9, and 6.0 and sublaterals, Contra Costa lateral system	June 18	July 23
Klamath-Tule Lake, California	Pumping units for Coppeck Bay Area Extension	do	Do.
Yakima-Roza, Washington	Earthwork, pipelines, and structures for lateral distribution system, Pump Areas Nos. 9A, 10, and 12	do	Do.
Deschutes, Oregon	Earthwork and structures, North Unit Main Canal, Station 3010+50 to 3562+30	June 20	July 25
Klamath-Tule Lake, Oregon	Pumping plants G, H, J, K, L, and M, Coppeck Bay Area Extension, Modoc unit	do	Do.
Boise-Payette, Idaho	Willow Creek pumping units	June 25	July 30
Columbia Basin, Washington	Air compressors and associated equipment for Grand Coulee power plant	June 27	Aug. 1
Central Valley, California	Main and station service control boards for Tracy substation	June 30	Aug. 8
Do	Motor control and station service boards for Tracy pumping plant	do	Do.
Colorado-Big Thompson, Colorado	25- and 50-ton cranes for Granby pumping plant	do	Do.
Columbia Basin, Washington	Domestic water pumps, chlorinating equipment for Mason City	do	Do.
Do	Unit and main control boards for Grand Coulee right power plant	do	Do.
Davis Dam, Nevada-Arizona	Conductor and conductor hardware for the Davis-Prescott transmission line	do	Do.
Do	Conductor and conductor hardware for the Prescott-Phoenix transmission line	do	Do.

[1] Subject to change.

Reclamation's Forty-Fifth Anniversary

Forty-five years ago this month the Bureau of Reclamation was established. At the time the Reclamation Act was passed on June 17, 1902, during President Theodore Roosevelt's administration, the agency was known as the Reclamation Service. Today it is the largest single agency engaged in the development of western river resources.



HOOVER DAM—Arizona-Nevada

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JULY
1947

In This Issue:

What "Multiple Purpose" Means
by
Wesley R. Nelson

UTAH'S CENTENNIAL

ly Experiences as a Ditchrider
by
Charles A. Lory

Public Library,
Kansas City, Mo.

E Reclamation ERA

This Month's Cover Girl

UTAH'S QUEEN

Pictured above in her royal regalia is Miss Calleen Robinson, who was chosen queen of the Utah Centennial. She is a true descendant of the original Mormon pioneers, who first practiced irrigation in the State a century ago, being the granddaughter of a Provo River project farmer. The sequin embroidery on the skirt of her royal costume represents the covered wagons used by her ancestors. The *Era* is indebted to Utah Centennial Commission photographer (Stephen J. Moloney) for this photo.

On the cover, Utah's queen is shown turning a valve on the intake structure of the Jordan Narrows Siphons. The siphons and the Salt Lake Aqueduct, which will convey Deer Creek storage water to the lands of the Salt Lake Valley as well as provide a domestic water supply for the people in that area, are nearing completion 100 years after irrigation was first practiced in the same valley. The aqueduct will more than double Salt Lake City's domestic water supply. Cover photo was taken by Bureau of Reclamation's Photographer Paul E. Norine, Region IV.

Giving Credit Where It's Due

The excellent panoramic perspective drawing of the Colorado-Big Thompson project which appeared on pages 84–85 of the April *Era* was the work of Harry A. Grout, Region VII, Denver, Colo.

Reclamation ERA

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Letters to the Editor

Engineering News-Record on Record

The following letter to Assistant Commissioner of Reclamation Markwell is printed here with the permission of Mr. Cleary whose opinions are highly valued in the engineering field.

330 West 42nd Street,
New York 18, N. Y.
April 17, 1947.

Dear Mr. Markwell:

Had I not been informed that you were operating under a tight schedule when we were both in the Denver office last week, I would have endeavored to see you because I was eager to make a report on my inspection tour of regions III and V.

This note can hardly convey to you the spirit of enthusiasm with which I returned from my reconnaissance of reclamation projects. I am impressed with the scope and size of the undertakings themselves, but more importantly, perhaps, with the universally high caliber of the Bureau personnel. Nowhere have I come in contact with a group of men of such fine qualifications and devotion to the task in hand than I met on this recent trip.

Many attentions quite beyond the call of duty were extended to me and I made the most of every opportunity to acquire background and understanding of at least some elements of the present reclamation program. To supplement my field observations, I am now burrowing into reports and other literature with a view toward the preparation of copy for publication in *Engineering News-Record*.

The itinerary originally proposed by you was perfect. And the details handled by the field staff were beautifully coordinated. In this connection, may I tell you that Mr. Nelson and Mr. Moritz supplied very companionable and well informed guides in the persons of Jack Woodward of the Information Division staff in the Amarillo office, and Jack Shankland, an engineer assigned to the Construction Division at Boulder City. Thanks to both of these men the inspection was just as enjoyable as it was enlightening.

It is my intention to come to Washington at the end of the month so that I might have an opportunity of sitting in on some of the hearings related to the Arizona work and at that time I look forward to calling at your office to personally express my appreciation.

With kindest regards and best wishes, I am

Cordially yours,

Edward J. Cleary,
Executive Editor,
Engineering News-Record.

More on Benoclor

The Cloroben Corporation,
15 Exchange Place,
Jersey City 2, N. J.

Dear Editor:

The article "Benoclor-3-C" by W. Harold Hirst, which appeared in your April issue speaks of the weedkiller Benoclor as a "chemical." The phrase "chemical compound" would be more accurate, as the other usage may be misleading. The Benoclors are actually compounded of several chemicals for adaptation to different field conditions, and rendered useful through varying emulsifying agents. There is also connoted in the use of the word "chemical" the idea that the weed killing action is a chemical one, whereas the Benoclors perform more as a solvent than as such simple chemicals as sodium chlorate or calmium hypochlorite used in the weed-killing field.

While I have never met Mr. Hirst, I would appreciate it if you would extend to him my compliments for the accuracy with which he described the present techniques utilized in connection with Benoclor-3-C, and the results ascertained to date.

Incidentally, I live on Long Island, not in New Jersey.

Sincerely yours,

Herman Seydel, *Director.*

NEXT MONTH

A full report by Edward J. Cleary, executive Editor of *Engineering News Record*, of his reconnaissance of reclamation projects.

ALSO "Holing Through in 1909" by G. J. Van Gieson of the Branch of Design and Construction, Denver, Colo. The story of the famous Gunnison Tunnel.

United States Department of the Interior

J. A. Krug, Secretary

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The Reclamation Era regrets to announce the death of Superintendent L. J. Windle, of the Shoshone project, Wyoming, Region VI. W. F. Kemp has been appointed Acting Superintendent of the project.

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What "Multiple Purpose" Means

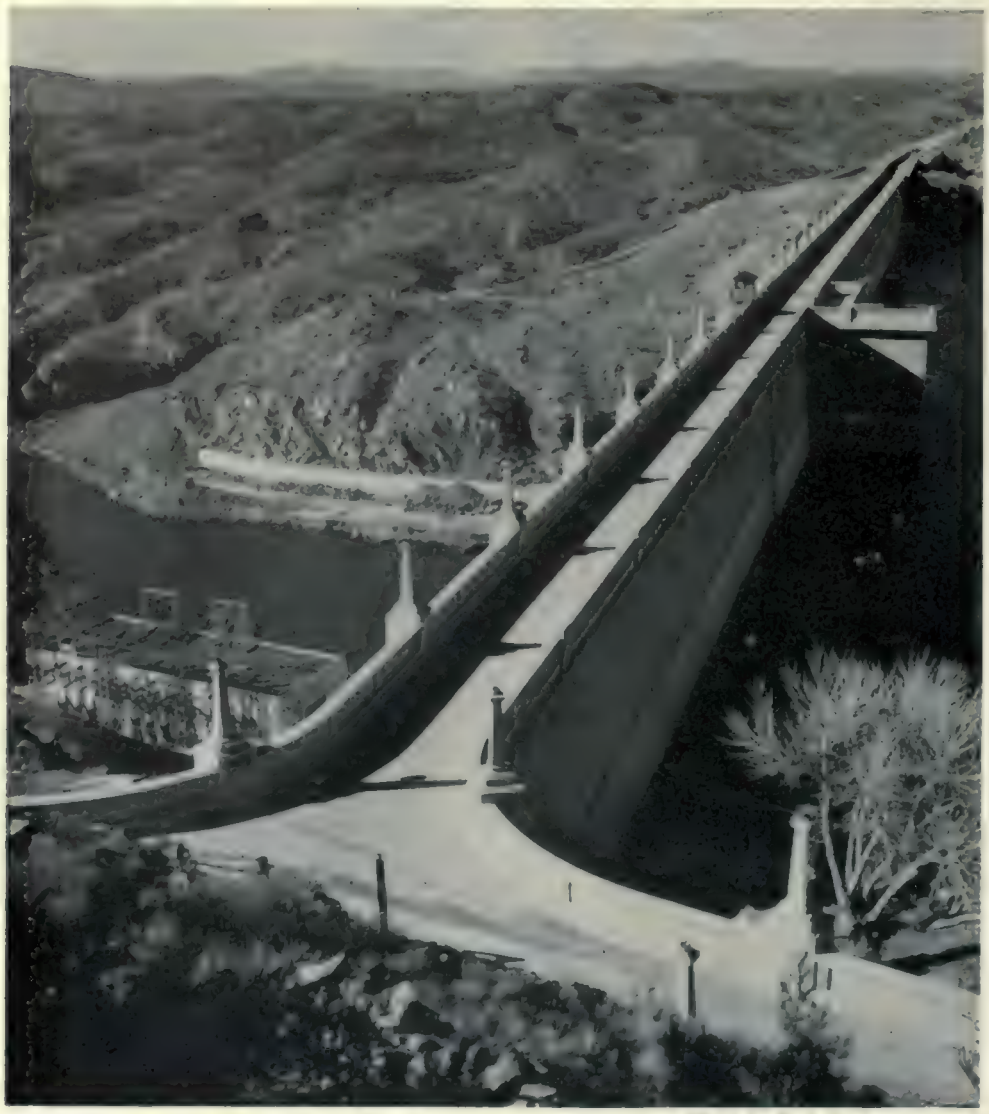


Photo by D. B. Parker, Region V

Elephant Butte Dam, Rio Grande project, N. Mex., source of hydroelectric power and municipal water.

NOT ONE of the irrigation storage reservoirs constructed by the Bureau of Reclamation can be considered as a single-purpose reservoir.

Although it may be planned, built, and operated for that one purpose, and the repayment of the cost of construction be made only by the irrigation interests, some measure of flood control, recreation, and fish and wildlife benefits is apparent in each of our storage reservoirs.

People have begun to recognize the existence of these multiple benefits more and more during the last 15 years, especially since the Bureau of Reclamation started to prepare plans for Hoover Dam. With this recognition has come the necessity of determining, within certain limits, the priorities of use among the various purposes. The State and Federal Governments have given, and are continuing to give, attention to this subject, and their ideas are reflected in the form of legislation. The operation of projects for irrigation and other purposes is dependent upon Federal and State policies, and the contracts with the beneficiaries. Design and operation of reservoirs have been changed to keep pace with these factors.

There is not a great deal of uniformity, and no standardization, apparent in the measures which have been adopted from year to year in the allocations to different purposes or in the methods of operations, but the examples which are given in the following paragraphs will, to some extent, explain the principles which are involved. The operating characteristics cannot be divorced entirely from the financial ones, because in Reclamation projects each is dependent on the other. Consequently, information on the cost allocations will be treated briefly in some cases.

The Rio Grande project of New Mexico and Texas, which covers 155,000 acres of irrigated land, extends nearly 180 miles along the Rio Grande upstream and downstream from El Paso. The international boundary between the United States and Mexico, beginning at a point immediately above El Paso, is formed by the river. Water regulation and storage are provided by the Elephant Butte Reservoir of 2,219,000 acre-feet capacity in 1940 (the date of the latest survey) 22 miles above the project lands; and the Caballo Reservoir of 345,000 acre-feet capacity, immediately above the project lands. A power plant of 24,300 kilowatt installation is situated at Elephant Butte Dam.

Caballo Dam and the power plant at Elephant Butte Dam were added to the project works about 23 years after Elephant Butte Dam was completed. Caballo Dam was constructed in part to provide control of arroyo floods, but its principal function was to provide afterbay storage capacity to reregulate releases from Elephant Butte Reservoir and make possible the generation of a large block of saleable power at the Elephant Butte plant.

The initial contract with the project water users, signed in 1906, called for repayment to the Federal Government of all costs of Elephant Butte Dam and Reservoir. In 1907, $1,000,000 was declared nonreimbursable by appropriation from the General Treasury in accordance with the Treaty with Mexico, signed May 21, 1906, whereby 60,000 acre-feet of water would be stored annually in Elephant Butte Reservoir and delivered to Mexico at a point near Juarez. The treaty contains a schedule of water delivery for each month, but for a diminished supply in years of extraordinary drought or serious accident to the irrigation system in the United States.

Although there was a storage allocation to flood control of 416,000 acre-feet, which covered the upper portion of the reservoir from the inlet of the cylindrical gates (elevation 4396) to the spillway crest (elevation 4407), there were no nonreimbursable funds allotted for this purpose.

After Caballo Dam and the power plant were completed (in 1938 and 1940 respectively), the cost allocations and repayment contract were revised. Approximately $1,500,000 was transferred to construction funds from the State Department to cover the flood-control allocation for the Caballo Dam. This action was a part of the program of the International Boundary Commission for flood control and river rectification along the international boundary.

An agreement was reached between the United States and the project water users whereby the remaining part of the costs for Caballo, the cost of the power plant and facilities, and the costs of construction of Elephant Butte Dam and appurtenant works were to be repaid solely from net power revenues.

An agreement on the operation of Caballo

by Wesley R. Nelson, Regional Director, Region V, Amarillo, Tex.

Dam also serves for flood control.

Photos by A. E. McCloud, Region V

Irrigation—number one priority.

Dam was reached with the State Department, whereby 100,000 acre-feet of storage would be available for flood control from June 1 to November 1 of each year. Although the major portion of the costs of storage works must be repaid from revenues derived by sale of power, water may be released from Caballo Dam only as it is needed for irrigation or if it must be spilled during floods after both reservoirs are encroaching upon their flood-control pools.

It is obvious that the reservoirs must be operated very carefully to obtain the maximum power development, and at the same time stay within the flood-control limitations, and avoid all discharge of unusable water from Caballo Dam. This situation is further complicated by provisions in the compact among Colorado, New Mexico, and Texas, which governs the distribution of use of Rio Grande waters above Fort Quitman, Tex., 80 miles below El Paso.

Benefits to fish and wildlife, recreation, and sediment detention have always been substantial at Elephant Butte Reservoir, but no allocations have been made to these uses.

The city of El Paso obtains a part of its water supply from project works. When the project was first planned, the city was given an opportunity to participate and receive a water supply. It elected to continue to get its supply from underground sources.

Recently, the increased population of the city, the influx of industry, and the establishment of a large army post produced a much greater demand on the underground reservoir than could be met by recharge. Since all the waters stored at Elephant Butte were required for project lands, it was necessary for the city to purchase lands and thus obtain rights to water that could be used for domestic purposes.

It was necessary to operate the project storage works for flood control in the spring and summer of 1942. Unusually large inflow into the reservoir in May and June in 1941 was followed by heavy run-off from the basin above the reservoir in the following spring. The outflow from both Elephant Butte and Caballo Reservoirs was held substantially below the rate of 11,000 cubic feet per second as required by the agreement with the State Department, but some damage was caused in areas near Hot Springs, between Elephant Butte and Caballo Reservoirs, where property had encroached upon the flood plain.

Under normal conditions, the discharge from Caballo Dam is entirely for irrigation, and Elephant Butte Dam and power plant are operated to avoid raising the elevation of Caballo Reservoir to a level that would make spills of nonirrigation water necessary.

Farmers on the project inform the ditch rider when they will need water, and how much will be required. This information is passed on to the project office where the figures are compiled and orders given for the release of water from Caballo. The operator at Elephant Butte Reservoir is notified of the amount of water that can be spilled from the reservoir during each month. On some occasions, particularly in the spring, when it is necessary to evacuate the flood-control pool at Caballo Reservoir, operations of the power plant are restricted.

The principal factors to be noted in the Rio Grande case are that decisions, with regard to allocations, were reached only when exigency demanded, as the circumstances indicated, and without an analysis of all benefits and potential allocations. However, the project works are so designed that they can be operated satisfactorily for irrigation, flood control, power development, and other purposes.

Although considered originally as a single-purpose project, the Alamogordo Reservoir on the Pecos River, 247 miles above the Carlsbad, N. Mex., project, which it serves, has captured or reduced the peak of several floods since 1937, when the dam was under construction. The present capacity of the reservoir is about 132,000 acre-feet.

Recognition of its flood-control potentialities is expressed in a Federal act (the act of August 11, 1939), which provides for the determination by the Corps of Engineers of the benefits the reservoir affords.

There are some fish and wildlife and recreational benefits, and prior to 1946 the draw-down was held to 5,000 acre-feet remaining in the reservoir. In 1946, the water shortage on the Carlsbad project became so acute that the reservoir was lowered to 1,500 acre-feet, the maximum draw-down that could be accomplished without damage to the outlet valves. No loss of fish was apparent.

Conchas Dam on the Canadian River in east central New Mexico, 35 miles northwest of Tucumcari, was completed by the Corps of Engineers in 1939. Storage capacity amounting to 600,000 acre-feet was assigned as follows: 100,000 acre-feet to sediment detention; 300,000 acre-feet to irrigation; and 200,000 acre-feet to flood control. Storage capacity for flood control is in that portion of the reservoir above the permanent crest of the dam spillway.

The Bureau of Reclamation is building the 38-mile canal from the Conchas Reservoir to the project lands and the irrigation distribution and drainage systems for a

Photo by Dale A. Hovey, Region V

Recreation, last but not least of multiple purposes.

project area of 45,000 acres which surrounds the city of Tucumcari.

None of the costs for the reservoir is to be repaid by the water users. The Corps of Engineers operates the dam reservoir, and all outlet works including the one for the irrigation canal. Releases of irrigation water are made as requested by the Bureau of Reclamation.

There is considerable fishing and boating at Conchas Reservoir, but no allocations have been made to benefits of this nature. It is probable that some fish will be lost from the reservoir through the irrigation outlets. This condition might be rectified by screening the outlets or by placing a trap in the main canal. A small 150-kilowatt plant provides power for the dam and camp operations. Water for operation of the plant is taken from any water available in the reservoir, without reference to a specific allocation.

The principal features of the Austin project in southwestern Oklahoma are the Austin Dam and Reservoir on the North Fork of the Red River, and a canal and distribution system for the irrigation of approximately 70,000 acres of land south of the dam. The reservoir capacity is 188,414 acre-feet.

The allocations made by the Bureau for regulation purposes are silt, 43,000; municipal supply, 4,800; irrigation, 103,850; and flood control, 36,764 acre-feet. The allocation of space for flood control is above the crest of the ungated spillway. The cost allocations, as established in the findings of feasibility, dated January 21, 1941, were $1,130,000 for flood control; $1,080,000 for municipal supply; $2,000,000 for irrigation; and the remainder, $1,390,000 for unemployment relief through the participation of the Works Project Administration. The estimated cost of the project has increased since the findings of feasibility but the increase has not as yet been allocated.

This is one of the projects for which the Secretary of War is to prescribe regulations for use of storage allocated to flood control under the terms of section 7 of the Flood Control Act of 1944 (act of December 22, 1944).

The tentative agreement, which has not yet been approved by the Interior and War Departments, is that the flood control discharge facilities shall be operated under the direction of the District Engineer of the Corps of Engineers whenever the pool stage reaches the crest of the ungated spillway. The District Engineer would then direct the operations of the discharge facilities to prevent flood damage below the reservoir and to limit the pool stage to an elevation 3 feet above the crest of the ungated spillway so far as possible.

Hoover Dam, one of the Nation's most successful multiple-purpose projects, is located on the Colorado River, 420 miles above its mouth, where the river forms the boundary between Nevada and Arizona. The dam is 8 miles east of Boulder City, Nev., and 71 miles northwest of Kingman, Ariz. The reservoir, Lake Mead, has a capacity of 31,142,000 acre-feet. The power plant, located at the toe of the dam, will have a total capacity of 1,322,360 kilowatts, of which 1,034,800 kilowatts are now installed.

The purposes for which the reservoir and power plant were built, as set forth in section 1 of the Boulder Canyon Project Act, are for (1) controlling floods, (2) improving navigation and regulation of the flow of the Colorado River, (3) providing for storage and for the delivery of the stored waters for reclamation of public lands and other beneficial uses within the United States, and (4) generating electrical energy as a means of making the project a self-supporting and financially solvent undertaking.

Engineering studies indicated that the lower 300 to 360 feet of the reservoir should be allotted to silt and sediment detention; the next 155 to 215 feet for active storage or river regulation; and the upper 75 feet for flood control.

The approximate reservoir capacities are 3,000,000 acre-feet for silt detention; 20,000,000 acre-feet for active storage and river regulation; and 9,000,000 acre-feet for flood control.

The initial legislation provided that the cost of all the works, exclusive of the allocation to flood control, would be repaid in 50 years at 4 percent interest through the sale of stored water and electrical energy, but that no charge should be made for water stored for the Imperial and Coachella Valleys.

The sum of $25,000,000 of the construction cost was allocated to flood control and was to be repaid to the United States out of a percentage of the revenues which were in excess of the amount needed to meet periodic payments during the period of amortization.

The Boulder Canyon Project Adjustment Act of July 19, 1940, revised the repayment plan. It provided that the payment of the $25,000,000 allocation to flood control was to be deferred, without interest, to June 1, 1987. The recreational and fish and wildlife benefits are very great at Lake Mead, but allocations have not been made for these purposes.

The balance of the cost of the dam and power plant was to be repaid with 3-percent interest from revenues from the sale of power and water.

As of May 31, 1945, the end of the project's operating year, $37,700,000 had been returned to the Treasury.

Among the unique provisions of the act were those providing for payment from power revenues to each of the States of Arizona and Nevada of $300,000 per annum, in lieu of taxes, for the operating years 1938 to 1987, and for the transfer, also from power revenues, to a special fund in the Treasury, designated as the Colorado River development fund, of $500,000 a year for the operating years 1938 to 1987 to pay for studies, investigations, and construction of projects in the Colorado River Basin.

In accordance with the terms of the initial authorizing legislation, contracts for the sale of water and power were obtained before construction was initiated. After the adjustment act was passed, the contracts were amended and arrangements made for two power allottees to operate and maintain the electrical generating and transmission facilities. The Bureau of Reclamation, however, operates all valves and gates which control the flow of water from the reservoir.

The water stored in Lake Mead must be conserved for municipal and irrigation uses downstream; therefore, power and flood-

control releases must be regulated in such manner that the water may be used to full advantage on the projects below the dam.

Among the more important projects already constructed below the dam are the Parker Dam power plant and the pumping plant of the Los Angeles aqueduct immediately upstream from Parker, Ariz.; the Palo Verde Irrigation project near Blythe, Calif.; Headgate Rock Diversion of the Colorado River project of the Indian Service; and the diversion dams for the Imperial Valley and Yuma projects near Yuma, Ariz. These vary in distance from 150 to 300 miles from the dam. Their needs for water fluctuate from day to day and because of the long distances involved, careful scheduling must be followed in order to avoid wastes on one side or water shortage on the other.

In addition, water releases and river control are required for the delta area in Mexico, under the terms of the Mexican Treaty, which became effective November 8, 1945. These requirements make it desirable to route all water requests to a river control officer of the Bureau of Reclamation, who compiles the data, coordinates it with the required operations of Lake Mead for power development and flood control, and designates the amount and time of water releases from Hoover Dam.

The Davis Reservoir is being built 65 miles downstream and will provide river regulation for power development, irrigation, flood control, improvement of navigation, and for municipal water supply. When completed, this structure should aid materialy in increasing the efficiency of operations of Hoover Dam. As the development of the Colorado River Basin progresses and the States of the basin reach an agreement on the allocation of the river's waters, the importance of Hoover Dam as the key structure in the river basin development will become increasingly apparent.

An enormous amount of study has been given to the design and operation of the Columbia Basin project, in the State of Washington, to obtain the maximum control and use of the Columbia River waters and provide the greatest benefits for multiple purposes.

Grand Coulee Dam, the principal feature of the project, is situated on the Columbia River 94 miles northwest of Spokane. Other features of this project are the 9,500,000 acre-foot reservoir back of the dam; power plants situated one at each end of the dam, which will have a final capacity of 1,944,000 kilowatts, of which 648,000 capacity is installed; the pumping plant of 16,000 second-feet capacity and 650,000 horsepower, which will raise water a maximum of 360 feet from the reservoir to the irrigation project works; a regulating reservoir of 1,202,000 acre-feet capacity; and 440 miles of main canals to serve the project area of 1,022,000 acres, lying in the Grand Coulee south of the dam. The power plant is connected to the high-voltage power network of the Bonneville Power Administration, which markets the power from the Bonneville plant, built by the Corps of Engineers at a site 450 miles below Grand Coulee Dam.

The principal purposes served by the Grand Coulee Reservoir are navigation, flood control, irrigation, power, and river regulation. Specific allocations of storage capacity have not been made to different purposes, the benefits being obtained through appropriate regulation of the reservoir.

Several more of the 54 operating projects of the Bureau of Reclamation could be described to point out certain distinguishing characteristics of design and operation, but the general principles would be similar.

The Rio Grande project is typical of those where there are definitely recognizable multiple purposes. Here it is evident that reservoirs can be operated for many purposes, without appreciable conflict between purposes, provided the various potential uses are recognized in the planning stage, and the designs prepared accordingly.

The designs and particularly the operation of reservoirs on Federal irrigation projects are not dependent solely on engineering considerations, river discharge characteristics, or the regulation of streamflow for optimum benefits for all purposes., They are influenced in considerable degree by financial and legislative matters which apply to each separate project.

It is extremely desirable to analyze all potentialities of proposed projects in order to avoid costly reconversion or duplication of construction features, and it is desirable, where feasible, to build and operate the works for all practicable purposes. At the same time, there should be recognition of all benefits in multiple-purpose projects and general uniformity and standardization provided in the determination of cost allocation. These objectives will be attained only as fast as the States and Federal Government make their decisions on water policies. This is especially true with respect to Federal agencies.

At present, there is much dissimilarity in the approach by different agencies to problems of investigations and operations, with consequent confusion in the handling of water matters. This situation can be rectified only by the adoption of an adequate national water policy. When this is done, and only when it is done, will it be possible to attain any appreciable uniformity in the determination of allocations for various purposes in multiple-purpose projects.

The above article is an adaptation of Mr. Nelson's speech delivered at the January 16th morning session of the annual meeting of the American Society of Civil Engineers, held in New York City during the week of January 13, 1947.

"Friendship of a Day"

Valley Evening Monitor, McAllen Tex., Photo

"*Amistad de un dia*" is what the Mexicans call it.

This fragile, paper-white flower is popular in the Lower Rio Grande Valley of Texas, where the Bureau of Reclamation is planning a gravity canal irrigation and drainage project to serve 700,000 acres of citrus fruit and vegetable producing land.

"Friendship of a day" is the English translation of the Mexican's name for the flower which blooms in profusion throughout its 2- to 3-month season.

Senator Klaghorn notwithstanding, some persons confuse the blossom with the Confederate rose.

Mexicans have another name for the flower, "algodon," or cotton, because its leaves are shaped like those of the cotton plant.

Mrs. T. J. Powell of McAllen, who belongs to the school of garden lovers which practices its belief that flowers bloom to be shared with one's friends, says the flowers, in spite of their fragile appearance, are admirable for luncheon corsages. They are sturdy, hold their shape well and do not wilt readily, whether in water, on the tree or pinned to a woman's frock. However, they would never do for dinner or dance corsages, because night closes them into tight red balls.

If these flowers be kin to the Confederate rose, Senator Klaghorn would have an answer for their refusal to bloom at night. "Why," he would demand to know, "should a southern beauty be spied on by the North Star?"

New Map Available

Western half of the United States showing Reclamation projects and the 7 regions. Map. No. 47–1, revised May 1947. Size 18 x 22 inches. FREE. Send your request to the Commissioner, Bureau of Reclamation, Washington 25, D. C.

Copy Photo by Paul E. Norine, Region IV

Arrival of the Mormons in Salt Lake Valley, July 1847, as depicted in artist J. B. Fairbanks' mural.

UTAH'S CENTENNIAL

By Mack C. Corbett

Region IV, Salt Lake City, Utah

Utah celebrates her centennial this year.

One hundred years ago, come July 23 and 24, the Mormon pioneers (143 men, 3 women, and 2 children) arrived in the Valley of Great Salt Lake, then a desolate wasteland. Practically their first act was to irrigate the land.

Historians vary in their interpretation of the significance of this and related events, but most authorities agree that July 23, 1947, is also the centennial of modern irrigation in America.

Aside from the year-long celebration throughout the State, including parades, carnivals, national athletic championships, light operas, theatricals in most communities, and a summer exposition in Salt Lake City continuing through September 20, the Utah Centennial may serve to bring about a broader understanding—at least in the minds of the thousands of visitors—as to the proper niche which Brigham Young and his colonists should occupy in the history of America.

Meantime, perhaps the estimate of Governor Osborn of Arizona would be of acceptable help in arriving at a true appraisal of what and how much Utah's Centennial means to sister States of the West at any rate. In *Arizona Highways,* Governor Osborn writes:

"The arrival of the Mormon Pioneers in the Valley of the Great Salt Lake one hundred years ago was a momentous event. It began the orderly colonization of the West. It began the heroic task of turning desolate wasteland into a productive empire, an achievement truly unequaled in the pages of history."

Encyclopedia Britannica (11th edition) says: "Irrigation of the western regions of the United States began in the Great Basin of Utah when the Mormon pioneers in 1847 diverted the waters of City Creek upon the parched soil of Salt Lake Valley."

Whether or not the Mormon pioneers can truly claim this "first," certainly theirs was one of the first instances of modern irrigation by Anglo-Saxons and certainly, in the words of Dr. John A. Widtsoe, it represented the first building of "communities of modern, civilized people under the ditch, comparable or superior to those in the rainfall regions from which they came." (See May 1947 *Era.*)

But in the last analysis, more importance attaches to what has become of all these beginnings.

The State of Utah now is a commonwealth of some 600,000 persons who enjoy living conditions comparable to the finest of present-day civilization.

Not without the greatest sacrifices, toil and bitter disappointments was Utah's progress, through 100 years of irrigation, made possible. Yet by the turn of the century, more than 1,000 miles of hand hewn canals had been dug and most of the lands irrigated in Utah today were under the ditch.

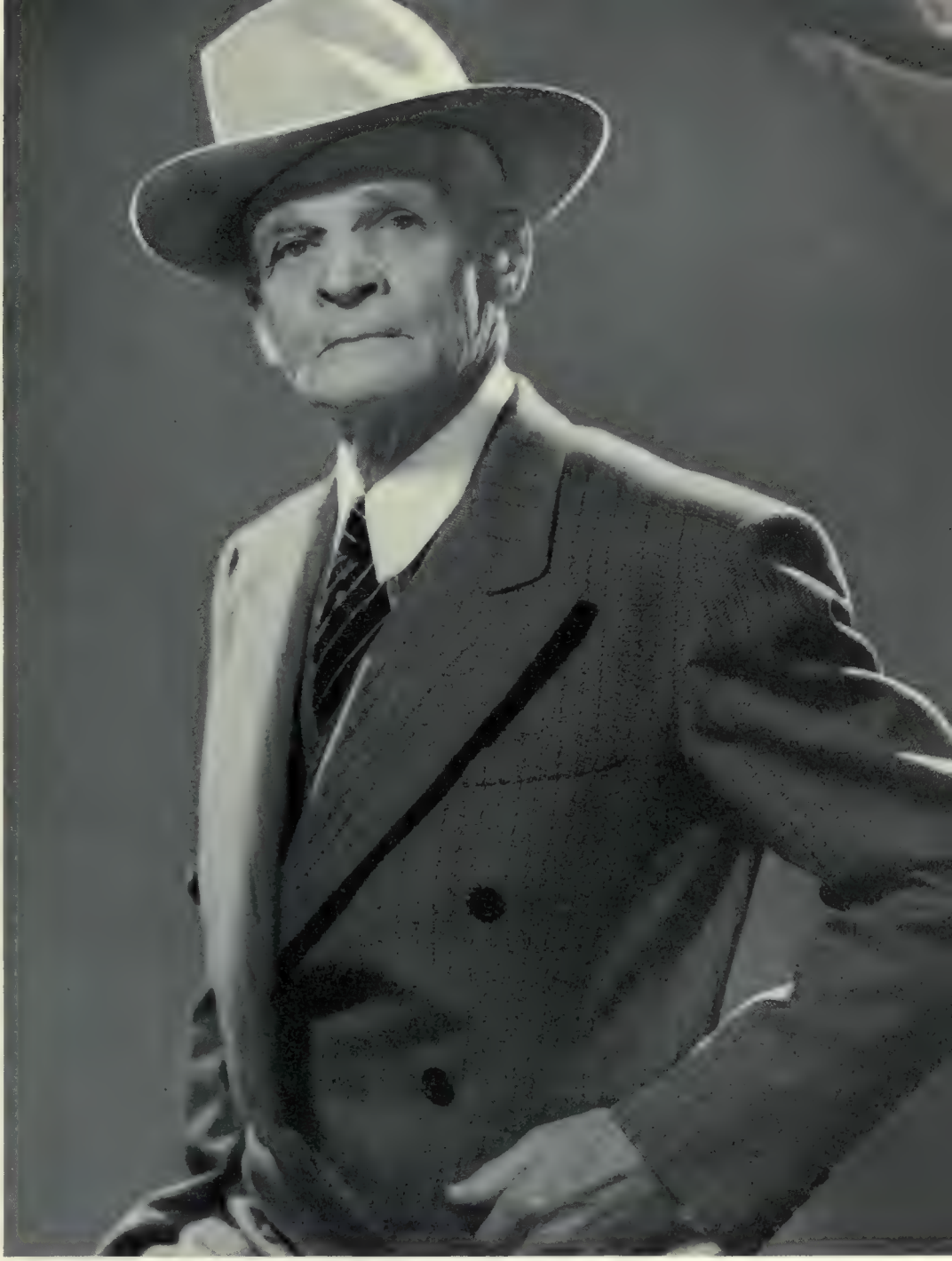
The Federal Government since 1906 has aided Utah's irrigationists, but chiefly in stabilizing the water supply to lands previously irrigated.

As a new century of irrigation dawns, Utah reclamationists are looking in desperation to the Colorado River Basin for a new water supply, and are seriously considering improvements to conserve existing water supplies.

The pioneer attributes of self-help and cooperation continue to be demonstrated in the Mormon State. In a larger sense, the Utah Centennial commemorates those attributes and commends them most strongly to the Nation as the basis for future understanding and progress.

Damming of City Creek by the Mormons marks beginning of irrigation in Utah.—J. B. Fairbanks mural.

Copy Photo by Paul E. Norine, Region IV



He Helped Combat Ol' Man River

by Randall Henderson
Editor of The Desert Magazine

In the late summer of 1913 the meandering Colorado River threatened to change its channel and leave the intake of the Palo Verde water system high and dry. C. K. Clarke, chief engineer for the water district, decided it would be necessary to install brush jetties on the Arizona side to divert the current to the California side where the Palo Verde intake was located.

But the Arizona shore was in the Colorado River Indian Reservation, and this made it necessary to go to the Department of the Interior for a permit, involving a delay that might be disastrous.

Because of the urgency of the situation, Ed Williams, then a director of the water company, volunteered to take a gang of workmen, smuggle them into the reservation, and get the control work underway while the application to Washington was going through the customary channels of red tape.

The river bottom on the Arizona side was a jungle of mesquite, cottonwood, and arrowweed. To find a route over which it would be possible to transport men and equipment through that jungle was Williams' first job. And since I had been a member of the United States Land Office survey crew which mapped the reservation the previous year, Ed invited me to go along.

We crossed the Colorado on the Ehrenberg ferry and spent 3 days finding a route through the dense thicket of trees and brush. Part of the time we were on horseback, part of the time on foot, and sometimes it was necessary to leave our horses and crawl on hands and knees. At night we rolled up in our saddle blankets and slept under the stars.

Out of those days together in that thorn-infested jungle developed a friendship which has remained warm to this day. And here is the story of the man who was my companion on that trip, and has remained one of my idols through the intervening years.

When Ed F. Williams went to Washington in 1930 to ask that $1,000,000 be appropriated out of the United States Treasury to compensate the landowners in Palo Verde Valley for flood damage caused to their holdings by the building of Laguna Dam, 70 miles down the Colorado River, officials to whom he made his appeal were not sure whether he was a colossal beggar, or just plain crazy.

"That's ridiculous!" exclaimed Dr. Elwood Mead, then Commissioner of Reclamation. "How could an 11-foot diversion dam in a river with a fall of one and a quarter feet to the mile affect the flood level of the channel 70 miles upstream?"

Phil D. Swing, Congressman from the Eleventh District of California, Williams' home district, also was skeptical. But being a diplomatic Congressman he did not ex-

This rock weir raises the level of the Colorado and keeps water flowing into Palo Verde intake just above. In the old days the same purpose was served less effectively by jetties extending out from the Arizona shore on the far side of the picture.

press his doubt as bluntly as did Dr. Mead.

"If you will show me how it would be possible for Laguna Dam to cause broken levees in the Palo Verde Valley, I'll give you what help I can," Swing assured him.

Before he had been in Washington many days, Williams saw he would get nowhere with his million-dollar request until he could prove to hard-headed engineers and indifferent Congressmen that there was engineering data to support contentions.

So he became a daily patron of the Congressional Library. He dug up old engineering reports from Egypt and India and Italy—some of them written 2 or 3 hundred years ago. It was necessary to have some of them translated into a language he could understand. For 6 weeks he read everything he could find about the hydraulics of a silt-laden stream.

He also found convincing proof from the records of the Colorado itself. For instance, the old adobe walls of the town of La Paz in Arizona opposite the Palo Verde intake had remained intact on the river bank through the highest floods on record since 1870. Then in 1914, 4 years after Laguna Dam was completed, a comparatively moderate flood crest overflowed the townsite and melted the walls to mere piles of mud.

When Williams finally appeared before the committees that were to consider his proposal, even Dr. Mead had been convinced there was good engineering authority to bear out Palo Verde Valley's complaint.

Williams returned to Washington again in 1931 and 1932 to press claims of his neighbors in the Palo Verde water district. Before the grant was made, however, there was a New Deal in the National Capitol, the RFC was born, and the Palo Verde landowners eventually received the aid they sought through the refinancing of their $4,500,000 bonded indebtedness at 25 cents on the dollar.

With the building of Hoover Dam the danger of flood damage from the Colorado River ceased to be a problem to the Palo Verde community.

Ed Williams' million-dollar errand at Washington merely was one of many tough assignments his neighbors have given him during the 36 years he has lived among them.

He was leader of the delegation which represented Palo Verde Valley during those highly explosive conferences when Los Angeles, Imperial Valley and other claimants were dividing California's share of the water allotted to the state under the Six-States Compact.

The Palo Verde delegates were not as strong in numbers or as eloquent in speech as some of the more powerful claimants—but they had two winning cards to play. One of them was a water filing on the Colorado River which was prior to all others in the lower basin. The other was Ed F. Williams.

Williams had spent many years of his life on the cattle range where gift-o'-gab was neither a virtue nor even an asset of any great value. He doesn't go in for speech-making. He told the conference in a few words what his district wanted. Some of the others thought it was too much, and stormed and threatened. In the end they gave way to the quiet-spoken delegate from Blythe who refused to be stampeded by professional oratory.

Ed Williams is 81 years old, with clear blue eyes that still sparkle with the enthusiasm of youth. Since 1912 he has played a leading role in the public affairs of Palo Verde Valley.

It is inevitable that a man so conspicuous in community leadership should be the target of rebuff and criticism. But Ed Williams takes the bitter with the sweet, and

never loses his quiet good humor. He is loyal to his friends and tolerant toward critics. His strength is that of a man who seeks neither wealth nor power for himself—and in whose heart there is charity toward all.

Williams has been on the frontier all his life. Born in Waverly, Iowa, in 1866, he was 16 years old when his parents moved to Dakota Territory in the heart of the Sioux Reservation.

He was a rosy-cheeked youngster, none too robust in health. His playmates in Dakota were mostly Indian boys, and his determination to equal their agility in the field

This old ferry operated between Blythe and Ehrenberg before the present bridge was built across the Colorado.

C. K. Clarke, who helped keep the Colorado "in a straight-jacket" for many years. He is now dead.

of sports soon developed his muscles to the point where he was a match for the best of them.

His parents had moved to Dakota when President Arthur opened part of the Sioux Reservation to white homesteaders. The Indians resented the encroachment on their lands and their attitude became so threatening President Cleveland revoked his predecessor's order and restored the land to the Indians.

This brought hard times to the Williams family along with other settlers, and Edwin, now 19 years of age, decided to fulfill his boyhood dreams and go West.

The next few years were spent in western Nebraska and Wyoming, trapping, herding, riding range—anything he could find to do. He was a novice cowhand at first but his likable personality gave him work when more experienced men were idle.

His schooling had been cut short when his parents moved to Dakota and after 2 years on the range he became conscious of the fact that he needed more education if he ever was to rise above a $30-a-month job.

To earn money for his school expenses he bought a trapping outfit and a winter's supply of grub and moved out into the uninhabited sandhill country of western Nebraska. He built a dugout and settled down for the winter alone with his traps and pony.

He had collected a sizable pile of coyote furs when the damp air of his crude dwelling brought on rheumatism. His condition became so bad it was an agonizing experience to move out of bed for food and water. Two horsemen stopped at his camp one night, and he persuaded them to lift him on his horse and guide him to the nearest cow camp, 40 miles away.

To this day Williams believes the men were cattle rustlers, but they were charitable enough to escort him along the trail to within view of his destination where they bade him goodbye and disappeared. It was many weeks before he was able to walk. When he returned to his dugout he found his pelts water-soaked and valueless.

But his determination to go back to school was not dampened. The next winter he outfitted for another trapping season. This time he went up into the Big Horn country. But the fates were against him. He was caught in a blizzard and frozen so badly before he was found, the doctors wanted to amputate his legs. He fought against the idea and finally compromised with the loss of the toes on one foot. It was 5 months before he was out of bed and a longer time before he could mount his saddle pony without help.

"I did not give up the idea of getting an education," Williams explained today, "but my immediate problem was to recover my health and get a job to repay the debts that had accumulated."

That was in 1887. When he could ride again Williams went to Buffalo, Wyo., where he worked for several months with a cattle outfit. Then he and Buck Taylor took the old Mormon trail and headed for Nevada and went to work on the ranch owned by Governor Sparks.

A few months later Williams took the trail again, crossed the Colorado River at Lee Ferry and found a job near Flagstaff, Ariz. He spent the next 8 years around Flagstaff and Williams, eventually becoming range foreman under George Thornton, manager of the Bill Williams Cattle Co.

The old urge for an education returned and he spent much of his spare time reading and studying correspondence courses in English and grammar.

One winter he took a herd of 2,000 steers down into the Salt River Valley. That was before Roosevelt Dam was built and he became interested in tracing the prehistoric irrigation system and the Indian ruins found there. Some of his conclusions re-

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garding the mysterious Hohokam people have been borne out by recent research work of archeologists.

In 1902 Williams formed a partnership with Ed A. Tovrea, cattleman and packer, and made frequent trips into Chihuahua, Mexico, to buy livestock. On these trips he became acquainted with Col. Wm. C. Greene who was interested in the Sonora Packing Co. at Cananea. Later a three-way partnership was formed by Tovrea, Greene, and Williams. The firm prospered at first and had a high financial rating.

Then came the revolutionary outbreak in Mexico and Greene lost his concession. The United States was in a money panic at the same time and the partnership ran into financial difficulties. The net result was a reorganization in which Williams signed over his interest to his partners in return for the cancellation of certain indebtedness.

In the meantime another Arizona cattleman, Frank Murphy, had taken a lease on 43,000 acres of the old Thomas Blythe estate in Palo Verde Valley and was running cattle there. Murphy and Williams had been friends of long standing through their cattle dealings in Arizona.

In 1908 Murphy and the Hobsons with a group of California associates closed a deal for the purchase of the Blythe property. The old Blythe irrigation system was restored and extended and the land placed on the market for settlers. Murphy induced Williams to buy 160 acres and become a farmer. Later Williams filed on a homestead which he still owns.

Murphy and the Hobsons, operating as the Palo Verde Land & Water Co., found a ready sale for the lands in their newly-opened irrigation project, and the townsite of Blythe was laid out.

In the spring of 1912 the Colorado River broke through the protective levees at the upper part of the Valley and overflowed many thousands of acres of newly reclaimed land. This disaster hastened the climax of a feud which had been in progress between settlers and the holding company for many months over the management and financial set-up of the irrigation project. Murphy and the Hobsons had formed a subsidiary corporation, the Palo Verde Mutual Water Co., to manage the water system, reserving a large block of the unsold water stock for themselves.

The settlers objected to the terms of the contract between the land company and the water company, and resented the fact that the control of the water company was entirely in the hands of the Murphy-Hobson group. They felt they should have a voice in levying water assessments and selling water stock.

A general meeting between representatives of the two groups was held at Hotel Blythe in the fall of 1912. In the compromise settlement reached at this time the farmers were granted the right to name one member of the board of five water company directors—and Ed F. Williams was the unanimous choice for the post.

Thus began Ed Williams' active leadership in the public affairs of Palo Verde Valley. He was put on the board to represent the farmers who were his friends and neighbors—and he has been fighting their battles from that day to this. He has not always been on the winning side in the many controversites which are inevitable in a pioneer community—but no fair-minded person ever has raised a doubt as to Ed Williams' integrity, or his loyalty to the cause which he believed to be just.

One of the first things Williams asked for when he went on the water board was an engineer qualified to strengthen the river-front protection and plan an efficient canal system.

Frank Murphy said an engineer was a needless expense—anyone with common sense could build levees and plan irrigation works. Williams fought for his idea—and in doing so incurred the lasting enmity of his old-time friend from the Arizona range.

Williams finally was empowered to employ an engineer. He induced C. K. Clarke, who had been on the firing line in closing the break which threatened to inundate Imperial Valley in 1905 and 1906, to take the job.

"I am looking for an engineer who isn't afraid to tell the whole board of directors to go to blazes if he thinks they are wrong," Williams told Clarke. That kind of a job suited C. K. Clarke perfectly and he went to work. Williams worked with him, day and night, and together they planned and rebuilt the entire canal system.

Williams served on the water board 10 years, much of the time as president. At one time he also was on the drainage district board of directors and the levee district board. He knows the Colorado River and its vagaries as well as most of the veteran river engineers.

He was married in 1912 to Miss Edyth Everitt of New Mexico. Mrs. Williams was an artist of more than usual ability and the walls of the cabin they built on the top of a sand dune at the homestead are hung with many of her paintings. She died in 1934. Their one son, Edwin, Jr., was graduated from Stanford University and is now assistant to the librarian at Harvard University.

In 1923 while mowing hay on his ranch, the team of horses Williams was driving ran away and he was thrown into the sickle. As a result of this accident his right arm was amputated below the elbow. But such a handicap means little to Ed. Williams. He had to give up farming and today he is assessor and land agent for the Palo Verde irrigation district and secretary of Blythe Chamber of Commerce.

He likes to write, and has contributed short sketches on his frontier experiences to a number of publications. He has a portable typewriter with a cap keyboard and pecks away with his one hand, keeping contact with friends in all parts of the Southwest.

Williams never has amassed much wealth. He couldn't. He will fight for the interests of his friends and neighbors—but not for dollars or glory for himself. He belongs on the desert. He would be a babe in the woods in the fierce competitive struggle of the modern city.

He is an unusual combination of idealist and practical diplomat. He held his own in the rough-and-tumble days of the West of a half century ago—but his weapon was not a six-gun, although he could use one very handily. He fought with the quiet persistence of a man with infinite courage in his heart and a faith that believes there is some good in the heart of every human being.

The above article was reprinted through the courtesy of the publishers of the DESERT magazine, published monthly at El Centro, Calif. The story appeared under the same title in the September 1946 issue of that magazine. Minor changes have been made to bring it up to date.

Films for Reclamationists Abroad

Reclamationists abroad have frequently asked the Bureau of Reclamation if they could borrow some of our motion pictures and slide films. Unfortunately, we do not have a sufficient number of prints available to loan them for excessive periods.

However, arrangements have been made so that films may be obtained for use outside the United States. Contact your nearest American Diplomatic or Consular Office. The film you want may be already available in their film library. If it is not, that office, upon request, will contact the Department of State in Washington, D. C., and obtain a film suitable for the purpose for which it is intended.

AN ELEVENTH COMMANDMENT

"Thou shalt inherit the Holy Earth as a faithful steward, conserving its resources and productivity from generation to generation. Thou shalt safeguard thy fields from soil erosion, thy living waters from drying up, thy forests from desolation, and protect thy hills from overgrazing by thy herds, that thy descendants may have abundance forever.

"If any fail in this stewardship of the land thy fields shall become sterile, stony ground and wasting gullies, and thy descendants shall decrease and live in poverty or perish from the face of the earth."

By Dr. W. C. Lowdermilk, in an article on Palestine.
From "Farmers Newsletter," March 1947, New South Wales.

OUTPUT AT INTAKE

Shortages of supplies and equipment were a problem, but "Joe McGee" design and construction came to the rescue of the farmers on the Intake project in Montana.

by Joseph W. Grimes

Construction Engineer, Terry, Montana, Region VI

THE situation looked bad.

Farmers on the small (840-acre) Intake project had hoped to irrigate their crops last summer. The Bureau of Reclamation had anticipated that enough construction would be completed to permit delivery of water to their lands for the 1946 irrigation season. Crops had been planted, and an exceptionally early irrigation season materialized.

But shipments of equipment needed to hook up the power lines for pumping water from the main canal of the Lower Yellowstone project were not forthcoming. The plan had been to furnish water to Intake, which is located on both sides of the Lower Yellowstone project canal, by means of two pumping units.

Construction of irrigation facilities had been begun during June 1945 and were finished during March 1946. Everything looked fine, until it was found that the electric power features would not be completed in time to start pumping water to the lands. The manufacturers solemnly pointed to the materials shortages which were plaguing them, and which have created problems in Reclamation activities both during and since the war.

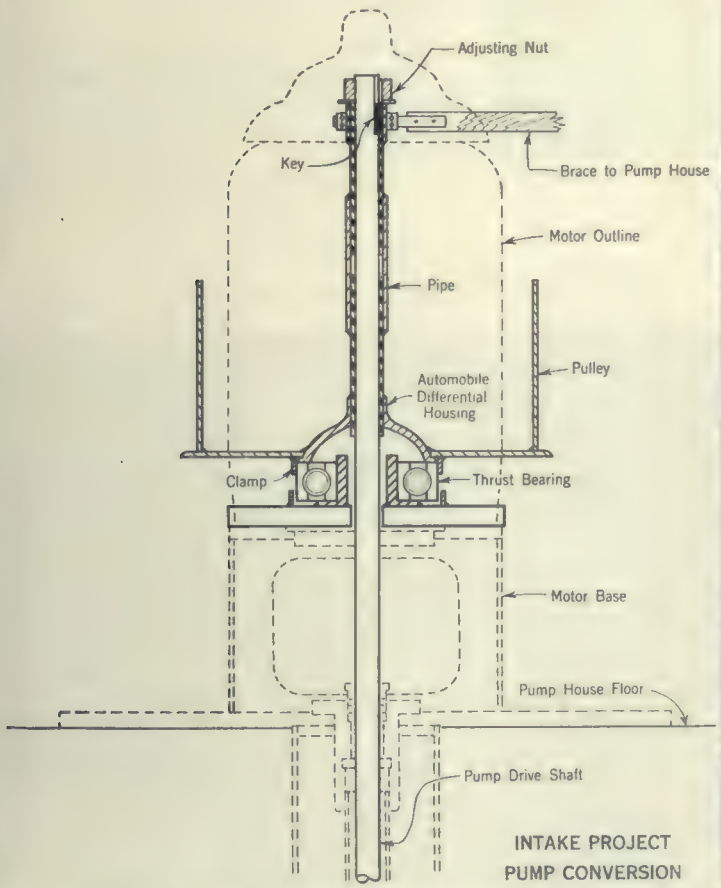
From an over-all viewpoint, the possibility of losing Intake project crops might not be considered very great, but to the farmers on the project, and the Bureau's engineers, it was a heavy blow.

They refused to let the shortage of critically needed materials beat them. A few parts from the "junk" pile, a borrowed gasoline engine, and "Joe McGee" design and construction combined to save the farmers from a dry summer. A drive pulley and thrust-bearing mechanism were fabricated. A gasoline power unit was borrowed from an aggregate screening plant, and to deliver water to the lands on the other side of the main canal, two construction unwatering pumps were used.

The photograph shows the pumping setup. The sketch shows the drive pulley assembly. Although use was anticipated only for a short time, this temporary installation furnished enough water throughout the 1946 season to save the crops which had been planted.

The Intake project is located in Dawson County, Mont., northeast of the town of Glendive. It is a water conservation and utilization project authorized under the legislation popularly known as the Wheeler-Case Act. Typical of W. C. U. projects, Intake has a small acreage, receives some rainfall, but is in need of irrigation to stabilize the agriculture of the area.

Sufficient substation equipment is now installed to provide for normal electric operation, but the people around the Intake project fondly remember their "junk pile" pumps which were developed out of a combination of dire necessity and ingenuity, to beat the shortage of materials, and give them enough water to produce their planted crops on schedule.



"Joe McGee" design and construction plans.

Improvised pumping system in action.

Careers

Presenting some of th
of the West who creat

by Jo

Davis Dam
Bou

Photo by Ray L. Wiggins, Region III

Bahmeier and some of the "gang" talk it over.

You can tell them a mile away.

Dam builders on western rivers they are. At first you aren't sure what it is that makes them stand out. You may never know unless you happen to see Hoover or Shasta or Grand Coulee, or any one of the Bureau of Reclamation works. But you will know then. For they are men who dare to challenge nature, and win.

Conquerors they are. They have harnessed rivers in stone. Not ordinary rivers, but the wild, turbulent, powerful rivers of the West—and they have fashioned a harness that keeps them under control.

At Davis Dam, Reclamation's huge postwar project, you can see many of these men. They are preparing another harness on the lower Colorado River to wrest irrigated crop lands and electric power and flood control and other useful attributes from that mighty stream. They swarm over the cuts and fills. Engineers, foremen, muck shovers, bulldozer wranglers—all kinds and types of men are there.

Some have risen to places of responsibility. Others are "construction stiffs" without engineering education but with plenty of know-how. Whatever they are doing, they are dam builders to the core, and already they are looking to the next "tallest-in-the-world" or "largest-in-the-

H. F. Bahmeier, the Bureau's "head man" at Davis.

Photo by Ray L. Wiggins, Region III

Howard S. Doolittle, electrical boss for Utah Const. Co.

Photo by Ray L. Wiggins, Reg

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world." For they will help build those, too. Once a dam builder, always a dam builder.

Jobs are big, done in a big way. That does something to a man. Other occupations seem tame, uninteresting. And underneath is the warm glow which comes from knowing that you have achieved. The reclamation works and their results speak for themselves. The dam builder's career in stone is a mark to man's progress.

At Davis Dam you can see these men. H. F. "Pete" Bahmeier, Jack Lloyd, Harold R. Orr, H. E. McInnis, Howard Doolittle, H. E. "Ernie" Williams, T. L. "Ted" Terry, Paul Newell, Jean Walton, Jim Fordham, George W. Lyle, Bill Matthews, Gus Larson, and many a Joe Blow who takes the jolts of a jackhammer for 8 hours a day or snakes a bulldozer over the rocky hills at the dam site—they are all there.

In the last two decades of the Bureau's accelerated building program their trails have crossed many times, and some of them knew each other on Bureau projects as long as 30 years ago, working from Arrowrock, to American Falls, to Gibson, to Shasta.

At Davis now you hear, "Hello, Jack, I haven't seen you since Hoover. What the devil have you been doing? Farming?"

Many of the older engineers of the Bu-

Photo by Ray L. Wiggins, Region

Action at Davis. Slope of channel is dynamited to flatten sidewalls.

H. E. Williams, project manager for Utah Const. Co.

Photo by Ray L. Wiggins, Region III

Chief Clerk James H. Fordham is the detail expert at Davis.

Photo by John A. Leveritt, Region

reau have spent entire careers as dam builders. Some are internationally known. The dean is John L. Savage, former chief designing engineer, who now travels far and wide as a consultant for dams and irrigation developments in such places as China, India, and Palestine.

The younger engineers are there, too. They are adding to their careers the "know-how from the school of hard-knocks." And brother, in the construction branch of that school, the knocks really come hard.

This is also true of the forces for the Utah Construction Co., contractors for the dam. From the general superintendent down to the last foreman they have to be smart and fast or get back on the working end of a wagon drill—working for somebody else.

There is Construction Engineer H. F. Bahmeier, the top Bureau representative on the job. He gained experience at Island Park, Vallecito, and Anderson Ranch Dams. Mr. Bahmeier carries easily the responsibility of directing the $77,000,000 Davis Dam project. Thousands of details of such a job are at his fingertips, but he is never too preoccupied for a friendly greeting.

Project manager for the Utah Construction Co. is H. E. Williams, a veteran western engineer. You would swear that he is joking when he blandly admits that he is 62 years old. His vitality matches his 40-year-old look.

T. L. Terry is the contractor's general superintendent and he is not the kind of superintendent who runs a job from an office. In covering the job he forgets that his shiny sedan can't keep pace with a bulldozer everywhere it goes, and often the dozers have to get him out of spots. Pleasant and smiling until things get fouled up, he is sometimes as explosive as a 16-inch rifle. His nicknames tag him. Some of them are "TNT," "Little Giant," and "Terrible Ted," all of which indicate he is a guy who gets things done.

A couple of real veterans on the job are Jack Lloyd, superintendent of excavation, and Howard S. Doolittle, electrical superintendent, both of whom got their first jobs on Bureau projects about 1913.

Jack has over 30 years of almost continuous service either working for the Bureau or for contractors on Bureau jobs. He started as a laborer on the Strawberry Valley project in 1914 and by 1931 had enough experience to become the excavation superintendent on the swing shift at Hoover Dam. Jack did take a little time off from dam building during the war. Working for the Army engineers, he was flown all over the Pacific to show GI's how to move dirt for the construction of air fields. He nearly made it safely but a Kamikaze pilot bombed him after VJ-day. Besides Hoover, he worked on American Falls, Gibson, Parker, Bartlett, and Shasta Dams. He is rather proud of moving a million yards of muck during the first month of operations at Shasta.

Howard Doolittle in his field can match Lloyd's experience. He started on the Meadow Creek Dam in 1913 and was working for the Bureau on the Tieton Dam in 1924, when he joined the Utah Construction Co. on the American Falls Dam. Since then he has worked for contractors on Gibson, Deadwood, Hoover, Bartlett, and Grand Coulee Dams.

A young engineer is Paul R. Newell, project engineer for the contractor, who is a "chip off the old block." His father, R. J. Newell, is director of the Bureau's Region I. Paul had a hand in Hoover and Grand Coulee, too.

Like an adjutant in an army unit, Davis' chief clerk, James H. Fordham, keeps details from foundering the project. He didn't learn his way around a construction project pushing a pencil. He worked for the contractors on Hoover Dam and was raised in the home of a Bureau master mechanic who is now retired. Jim served with the United States Navy during the war and upon his return to civilian life was transferred to the Davis Dam project.

Another dam building veteran is George W. Lyle, assistant chief clerk, who joined what was then the Reclamation Service in 1912. Mr. Lyle's first dam was Arrowrock. Since then he has worked in the Boise and Minidoka project offices, at Parker, and at Alcova and Seminoe Dams on the Kendrick project. He expects to retire when Davis Dam is completed.

Harold R. Orr is the office engineer for the project. Quiet and methodical, he is second in command and takes over when the construction engineer is away from the office. Harold has worked in the design section of the Denver office of the Bureau and has a varied engineering background.

Mr. Bahmeier's other chief assistant is Field Engineer Jean R. Walton, who joined the Bureau in 1936 on the Vallecito Dam. Another young engineer who is piling up a winning record on Davis Dam, Jean served with the Army Engineers during the war.

Gus C. Larson, general plant foreman for the contractor, cut his dam-building teeth at Echo Dam in 1929 and has since worked at Hoover, Parker, and Shasta Dams.

Such are the dam builders at Davis. As they work on this new venture, their thoughts race on beyond the verdant farms their dam will make from desert wastes to the next job ahead. For they are conquerors of rivers. Optimistically, the contractor's men say, "We'll be through here just in time for Bridge Canyon. Taller than Hoover and longer. That's the one we want to make."

Weed Control Research Program to Aid Farmers and Irrigation Districts

Recent studies made by the Bureau of Reclamation on present costs of weed control and losses created by weed infestations are bringing about a better understanding of irrigation weed problems, and the urgent need to solve them more permanently and economically.

Definite steps are being taken to determine which of the widely varied methods of control are the most economic, to improve these methods and, if possible, to find new ones which will be even more effective. In the past temporary, but costly, methods were often used because little scientific research had been conducted on weed problems peculiar to irrigation conditions.

Realization of the need for more basic research led to an agreement with the Department of Agriculture to conduct such research for which the Seventy-Ninth Congress made an appropriation to that department. The research work is under the direction of Mr. L. W. Kephart, Senior Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering. The Bureau's cooperation consists of furnishing some of the facilities and giving information on weed problems needing further study. This phase of the program is under the direction of Agronomist R. B. Balcom of the Commissioner's office in Washington, who in turn is furnished data by the Weed Specialists of each region.

So far two field stations have been set up by the Bureau of Plant Industry. One is located in the Boise Valley near Boise, Idaho, and is directed by Agronomist J. M. Hodgson; the other, in the Salt River Valley near Phoenix, Ariz., is directed by Agronomist L. S. Evans. At these two stations tests are being made to find more effective methods of combating weed problems of the Northwest and Southwest respectively. It is planned to establish a third station later at Prosser, Wash.

The Chemical Laboratory in connection with the Chief Engineer's office in Denver, Colo., is also cooperating in the program and much of the initial research will be conducted there in cooperation with Bureau Chemist W. T. Moran and his associates, and Bureau of Plant Industry Plant Physiologist Dr. R. S. Rosenfels. The laboratory work consists of life history studies of certain plants (particularly of water-weeds which infest irrigation channels) and primary tests on the effect of various chemicals on weeds and crop plants. As the screening tests are completed in the laboratory, the most promising findings are turned over to the field stations where tests are made on a larger scale and under field conditions. Much of the work is also being conducted in cooperation with the State colleges in the West. As soon as recommendations can be given, they will be made available to both private and Federal irrigation projects.

The Bureau of Reclamation has also in-

(Continued on page 167)

My Experiences as a Ditchrider

by Charles A. Lory

EDITOR'S NOTE: Dr. Charles A. Lory, President Emeritus of the Colorado State College of A. & M. is a well known authority on reclamation. He has served on a number of occasions as a consultant for the Bureau of Reclamation and in 1937–38 served as chairman of the Repayment Commission. In this latter capacity he visited Federal reclamation projects, including Indian irrigation districts, meeting with groups of water users and State and agricultural college officals. The Commission was authorized by Congress to study the reclamation projects and to devise a more equitable and more flexible permanent plan for repayment of the construction costs.

Five years' residence in the Big Thompson Valley, Colorado, work as a farm hand one season, teaching school a short term, farming with my father four seasons, and 6 months on a canal construction job were my qualifications when President Jay H. Parish and the Board of Directors of the Hillsboro Irrigation Co. employed me as ditchrider in the Spring of 1893.

The Hillsboro Canal furnishes water to about 9,500 acres on the Divide between the Big Thompson and Little Thompson Rivers. Its diversion dam is about 3 miles east of Loveland and its total length to the Little Thompson Extension, 14 miles.

Its water right consisted of 1.25 second-feet, priority No. 30; 99.46 second-feet, priority No. 42; and 45.69 second-feet, priority No. 54, or a total of 153.4 second-feet when the Big Thompson River flow was 2,358.56 second-feet.

The Miners inch, approximately 40 to the second-foot, was the unit used in distributing water. The canal depended entirely on river flow, and daily fluctuations were large.

I reported for duty in April, assisted in repairing the diversion dam, rating flume, many headgates, and supervised the cleaning of the canal. In May another rider was employed to care for the headgates and upper 4 miles of canal. We had no telephone connection with the office of the Water Commissioner, and since ours was the lowest large canal on the river, both of us were convinced it got all the drops in river flow and few of the raises. We rode horseback and were required to ride the bank of the canal.

The rider of the upper section met me each morning at the end of his section, and reported the flow at the head, and what he had distributed. I then distributed by allotment, as called for, to the farmers, in my 10-mile section. In order to distribute the water as accurately as possible, I generally rode my section twice a day.

I know that honesty is the only policy for a ditchrider. I soon learned not to expect a man whose crop is "burning" to be reasonable, that gossiping causes trouble, and it is foolish to tell men on the upper section of the canal what some on the lower section think of them—especially in a dry year. Nineteen hundred and three was a very poor water year and crop losses, due to lack of water, severe.

The worry of the job, the physical strain of long days in the saddle, and the pioneer habit of using ditch water for domestic purposes brought on an attack of typhoid fever early in July, and my work as ditchrider was over for the season.

The next season I accepted the position of ditchrider on the Big Cut Lateral and Reservoir System, which furnished water for about 2,400 acres in the Oklahoma District, on the south side of the Poudre Valley, midway between Loveland and Greeley, Colo.

The system consists of the Big Cut for conveying water from the main canal of the Greeley Loveland Irrigation Co., the Lake Canal, Highline Canal, Reservoir, and North and South Laterals.

The system was quite short of water. In its development 4 years before, due to extreme shortage of funds, the stockholders purchased only 80 acres' rights from the Greeley Loveland Irrigation Co. for their quarter sections of land, depending on their reservoir, which holds 4,931 acre-feet, to supply the deficiency. This storage, however, proved too small, and in later years most of the farmers purchased reservoir rights in Lake Loveland, the Seven Lakes Reservoir System, Boyd Lake, and recently from the Colorado-Big Thompson transmountain diversion project, now under construction.

The Colorado statute inch (38.4 statute inches equals 1 second-foot) was used in water distribution and measured over rectangular weirs. The water from the Greeley Loveland Canal was distributed to the farmers, according to their investment in Big Cut Lateral and Reservoir stock, and in Greeley Loveland rights. When a majority of them wanted more water, the Board of Directors ordered this drawn from the reservoir, and directed how much per share, until the reservoir was empty.

This plan worked well for the farmers growing grain and alfalfa, but was a distinct disadvantage for potato growers. This was before sugar beets became an important crop. The potato growers tried to provide late water by exchanging with the grain growers, but risked loss through deficiency in late Greeley Loveland water.

During my service as ditchrider we developed a system of distributing the water on order by using the reservoir for reserve storage and supply. It required much argument and some trips to the experiment station at the State agricultural college to determine how much reservoir water should be credited to the stockholders, how much loss should be charged for evaporation and seepage of the reservoir, whether to cancel all accounts if the reservoir should be filled during the irrigation season, and the form of report to the farmers.

From the official survey of the reservoir and a careful record of withdrawals, the board was able to assign credit for reservoir water at the beginning of the season, with assurance. A record of the water distributed every day, on orders placed not later than the day before, showed the amount drawn by the farmer, how much of this came from the Greeley Loveland Canal, how much from the reservoir, or how much was stored to his credit, and a complete statement for the week, with balance of water to his credit was given him on Sunday.

This system encouraged planning of work, efficient use of water, good methods of irrigation, and resulted in better crops. The farmer ordered the volume of water he could best handle on his type of land for his particular crop, and when through, he ordered the water shut off.

Homemade recorders of depth of flow on the master weirs at the Big Cut and Reservoir outlets were effective in checking fluctuations and the accuracy of measurements. Later, I used meters that recorded the dis-

(Continued on page 168)

Above photo taken by Joe W. Buller, Region VI, represents a bortz drill bit enlarged to three times its original size. This particular drill has already cut through more than 375 feet of solid rock.

No mere ornaments, these sleuths of the underground do their share in developing the Missouri Basin project.

by R. L. Branam

Region VI, Billings, Mont.

THE JEWEL ON MILADY'S HAND, and the untouched water resources of the Missouri Basin have something in common.

With nearly every force known to man being thrown into the gigantic task of harnessing the waters of the Missouri River and its tributaries, it is appropriate that the diamond, one of nature's most precious possessions, has been called on to do its full share.

In spite of its background of glamour, the diamond is performing a workman-like job in a most unspectacular manner—taking samples from the earth's crust as part of the exploration of subsurface formations.

The diamond used for this work is not of the type that adorns the jeweler's show window, but is nearly as rare and costly and

Looks like coal? THAT is $25,000 worth of diamonds.

Photo by Joe W. Buller, Region VI

"Weighing them in" at the Coulee Dam geology laboratory.

Photo by F. B. Pomeroy, Region I

even more important to the future of man. It is the tough noncrystalline black diamond or carbonado.

Contributing directly or indirectly to many phases of the program currently underway for greatest possible utilization of water resources of the Missouri River drainage basin, the black diamond and bortz (an imperfect gem-type stone) have come to the forefront with the recognition of their excellence as the cutting edge for core drill bits.

The units to be constructed for irrigation, power production, and flood and silt control in the river basin, must last for years to come. To make sure that all structures are built upon a firm foundation, every effort is being put forth to assure complete preconstruction investigations.

Particularly important in this phase are investigations made in connection with the location of dam foundations.

After selecting tentative sites for a dam, engineers call on the geologists to explore the vicinity and decide whether it's safe to build.

The geologists then look over the selected site and adjoining areas (they call it a "reconnaissance") and point out the places where more detailed explorations by diamond core drilling are needed to yield more information.

It is in this phase of work that the diamond assumes its all-important role as the Sherlock Holmes of the underground.

Unlike the sleuth of fiction, however, the black diamond does not work alone; it must be teamed with others. An experienced commercial diamond setter drills a number of cavities (usually varying from 6 to 16) on the circumference of the steel bit to be used. Each hole must be custom-made for the diamond it is to receive. Up to this operation, the diamond setter's job is like that of a dentist. From then on, he becomes a jeweler, dealing with a mammoth mounting of irregular stones. Each diamond is encircled by a thin strip of lead or copper to act as a cushion, then two heavy chisel cuts are gouged out of the metal and punched around the stone to calk it. Only one-fourth to one-tenth of the stone is allowed to project beyond this "setting." The secret of setting these stones (and the most difficult part of the operation) is to make these projections even. This is no easy task when dealing with stones of irregular shape.

When the diamonds go to work, all set in their core type bit (a short metal cylinder) they are sometimes accompanied by another hollow tube called a reaming shell, also set with a few diamonds around the outside. This protecting cufflike apparatus is used to keep the hole up to gage and to provide space for the bit cuttings. These two companions, coupled to the core barrel, are rotated by a drill machine and begin boring into the depths of the earth.

As the bit advances, water is pumped through the drill rods to remove the cuttings from the hole. These round cores of rock (varying in diameter from 1 to 4 inches in the Missouri Basin investigations) rise up through the core barrel as the earth gives up a cylindrical cross-section of its secrets to be deciphered by the geologists.

The drill rods and core barrel are taken off at intervals and the section of rock removed, thus giving the geologists a continuous sample of the underground formations.

The samples are then classified, logged, and plotted so that the engineers can determine whether the earth beneath is suitable for the construction of the engineering feature under consideration.

The diamond core drill, in addition to being the fastest means of cutting samples from the underlying rocks, does not disturb the bedrock through which the hole is drilled. Consequently, it is possible to utilize cored holes for purposes other than providing a means of identifying formations.

Drill holes for dam sites are often subjected to water pressure to determine presence of openings through which excessive seepage could result and may be used for drain holes and grouting purposes.

In Region VI, Bureau of Reclamation diamond drilling operations have been completed on the proposed Tiber and Canyon Ferry Dams in Montana; Boysen, Owl Creek and Lake Solitude in Wyoming; Dickinson, Heart Butte and Broncho in North Dakota; and Shadehill in South Dakota, all units of the Missouri Basin project.

Drilling explorations are now underway on the proposed Cheyenne Dam in North Dakota, Angostura in South Dakota, Big Muddy Creek and Yellowtail in Montana, and diversion dams throughout the region.

Typical of drill explorations is the work in progress on the site of the proposed Yellowtail Dam, part of the Hardin Unit, Missouri Basin project.

This dam, as planned, will be one of the highest in the Northwest, thus necessitating extensive foundation explorations.

Three drills are now operating on the site selected by engineers for location of the massive structure, expected to be about 475 feet high.

Because of the tremendous weight of this high dam, the physical character of the rock must be accurately determined and the diamond core drill, as the best method of accomplishing this, is called upon to do its share.

Before work passes to the construction phase of Yellowtail dam, the sheer walls of

Vise holds drill bit as diamond sockets are bored.

Making diamonds fit into an unusual setting.

Photos by F. B. Pomeroy, Region I

Big Horn Canyon will have been explored, drills will have extracted continuous cores from the formation under the Big Horn River and investigations will have been made on the area surrounding the damsite. In this manner a firm foundation for the structure is assured.

The diamonds playing such an important role in speeding the basin-wide development program are of two classes.

The black diamond or carbonado, mined exclusively from the gravel beds of a practically unexplored region of Brazil, is a dull, lustreless, porous stone composed of tiny interlocking diamond crystals. Having no straight cleavage, it is tremendously tough and therefore the most highly prized stone for industrial use. Its chemical composition is exactly the same as that of the clear stone. It is the hardest and toughest substance known and is much less liable to fracture than the clear diamond.

The industrial diamond or bortz is similar to the gem-type stone but because of poor color and imperfections it is useless for this purpose. Nevertheless, although it does not have the toughness of the black diamond, it is of the customary diamond hardness and is used successfully for commercial purposes.

Although core drilling is the most important commercial operation using diamonds, it is but one of a legion of uses for the diamond.

Diamonds, reportedly, were first discovered before 800 B. C., in India. Two hundred years later the stones were found in Borneo.

These precious stones were used principally for the apparel of kings until 1430 when the custom of wearing diamonds for adornment was introduced.

As new fields opened in South America, Brazil, and later in Africa, scientific study was directed to the stone and with this inquiry the supreme hardness of the diamond was discovered and its use was turned to practical lines.

It was not until the turn of the nineteenth century, however, that the use of diamonds for commercial purposes was really started.

In the late 1930's, as hard alloys were discovered, use of industrial diamonds grew by leaps and bounds. Importation of these stones increased from 46,901 carats in 1929 to 3,809,071 carats in 1940.

The Bureau purchases the black diamonds through competitive bids. The call is frequently for diamonds weighing approximately 2.0 carats (1 carat=0.0065 ounce).

The announcement states, for example, that the Bureau wishes to purchase 25 stones of the first quality, without cleavage planes, of high density, homogeneous structure, rounded with no sharp corners, natural stones to be adequately chipped to show structure, bidder to submit his stones in parcel lots, state the price per carat of the entire lot in each parcel and the price for a selection of any stones in the lot. Bidders or their representatives either appear with the stones in person or send them by express or registered mail. When diamonds are not delivered in person it is always stipulated that the receiving representative of the Bureau be permitted to examine and check the contents before signing the receipt for them. The price of a first-grade black diamond, like that of the gem, is determined by its size. The going price (tax free) of a stone varies from $25 to $70 per carat.

The carbonado, demanding excessive prices until recent years, still sells for a price comparable to gem stones. Bortz, however, has consistently sold for a reduced price and can now be purchased for as little as $5 a carat.

As the demand for the stones increased, so did the supply. This was accomplished by introduction of byproducts or "common goods" (small chips of bortz and foreign material) and because of this development, the diamond now reaches into almost every field of industry.

It is fitting that the diamond, which has evolved from the stone of kings to an essential in the progress of mankind, should be employed directly in the Missouri Basin project, a program designed for the progress of the people in the river basin and the Nation.

The Truth About the Boulder Gold Rush

Tradition has it that when workmen began to excavate around Black Canyon, rumors spread that large deposits of gold were being unearthed at the site of Hoover Dam. In the absence of proof, the Bureau tried to squelch all such conjectures, but stories about the gold continued to circulate. Finally, at a meeting presided over by the late chief engineer of the Bureau, Raymond F. Walter, a citizen arose and shouted, "I want to ask you a question, and I want an answer. Did you or did you not strike gold in Boulder Canyon?"

"No," retorted Walter thoughtfully, "No, we didn't strike gold, but—we found diamonds."

"Diamonds? What do you mean?"

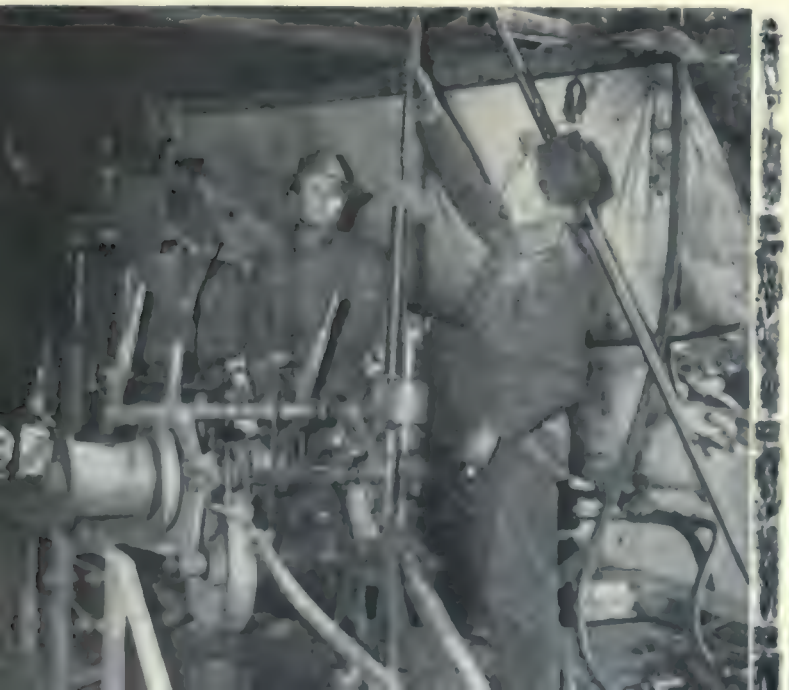
Walter said, "We found an old diamond bit that we lost back in 1929 when we were investigating the canyon. It was worth about $10,000."

According to legend, no more was heard about the gold mine in the canyon.

Diamond drilling machine about to start cutting cores at damsite.

Rock buried beneath the earth for ages enters light of day.

Photos by Arthur Fawcett, Region V



The 20th Century HOHOKAM

In the San Simon Valley "the people who are gone" are not forgotten, nor are the lessons they learned from bitter experience.

by William Scudder Gookin, *Engineer*,

Phoenix Office of Project Planning, Region III

Photo by William S. Russell, Region III

ARIZONA ABOUNDS IN MUTE EVIDENCES of the Hohokam, "the people who are gone." Long abandoned canals, deserted villages and scattered artifacts tell the story of this ancient people who came to the Valley of the Sun in ages past. Here they built a civilization, founded on irrigated agriculture, only to retreat before some mysterious adversary, leaving their homes and gardens to sear and wither under the blazing sun. When white men first came to this area even the memory of these departed ones had been lost. Only through the studies of archeologists are we able to unravel the mysteries of the Hohokam.

But Arizona contains evidences of another and more recent "people who are gone." About 10 miles south of Safford, abandoned canals, deserted homes, and scattered belongings tell a story of nineteenth century settlers who entered the San Simon Valley to pioneer new homes and communities. Subsequent events forced the abandonment of fields and homes and drove these people into other regions. In the San Simon Valley however, the facts of the story have not yet been lost. It is a story that began when our parents were young.

The story of the San Simon Valley is one that is of vital interest to all who are interested in irrigation. It is of value because a study of the story of the San Simon may serve to avoid a repetition of the heartbreak and economic ruin that was brought to many families by a deterioration in the agricultural economy of a community that was founded in a spirit of hope and progress.

Chiricahua, Dos Cabezos, and Pinaleno Mountains bound the San Simon Valley on the west while the Peloncillo Range forms the eastern limit—beautiful names surrounding a beautiful valley nestled between these peaks in the southeastern corner of Arizona. From the foot of these mountains the land slopes gently down to form the great shallow trough that is the valley of the San Simon.

Less than a decade after the Civil War, prairie schooners carried the first white settlers into this lush valley. Soon vast herds of cattle stood knee deep in the luxuriant grasses which covered the ground upon which the early ranches were established. Before long the San Simon Valley became known throughout the State as one of the most bountiful range lands in southern Arizona.

But man and nature conspired to strip this valley of forage. Ever-increasing herds of cattle overgrazed the lands in a relatively few years. Years of drought concurrent with this overgrazing served to destroy permanently many of the range grasses. A cycle of erosion started and progressed with a rapidity which made this valley famous among students of soil erosion.

For a short time it seemed that the area was destined to become a barren badlands after only a few short years of productivity. The range land had been rapidly exhausted, and farming was impossible without irrigation. The only dependable source of water in the valley was a few wells. Although ground water was less than 100 feet below the surface, and was adequate for domestic supplies, these wells did not yield enough for irrigation development.

However, in 1910 the situation changed overnight. A deep well was drilled in the valley, and tapped a basin of artesian water that lay hidden beneath an impervious layer of blue clay. As the water in this well rose to the surface, so rose the value of San Simon land. Here was a small scale bonanza, for in a country where water is the most precious commodity, finding an artesian belt is akin to discovering a gold mine.

Wells were drilled throughout the area in rapid succession. Many of these failed to strike artesian water, but by 1915 artesian water was flowing from 127 wells. These ranged in depth from 200 to 2,000 feet and served to delineate the artesian field, which covered an area about 15 miles long and 10 miles wide in the center of the valley.

However, once again the San Simon Valley was due to complete a cycle in a very few years. Expanded to a maximum neither cased nor capped. When the valley soon started another decline.

Developed as it was, without any knowledge of the physical limitations of land and water, it was inevitable that the San Simon Valley should suffer from a lack of long-range planning and orderly development. Most of the wells that were drilled were neither cased nor capped. When the artesian water was not needed, there being no way to stop the flow, it was allowed to dissipate into the desert. Such withdrawals from the artesian belt, while serving no useful purpose, decreased the pressure and consequently the flow from all wells in the area. In some cases various individuals installed pumps and attempted to supplement artesian flows by pumping. Inefficient pumps of the period, located far from any

source of low-cost power, were not the solution to the problem.

Many of the uncased wells caved in or filled with sand, and their output was further reduced. Owners of these wells were faced with the expensive alternatives of drilling new wells or cleaning out the old.

Only by bitter experience did the settlers learn that water in the western part of the flowing well area contains alkali or salts in such combinations and quantity as to be classified as "injurious to unsatisfactory" for irrigation.

Early irrigators, proceeding without the benefit of soil analyses and classification, did not in many cases select the best land for irrigation. The farmers were unorganized and unable to take any united action toward soil improvement and erosion control. As a result the lands in the valley progressively deteriorated.

Within the San Simon Valley may be found graphic examples of the effects of an enforced reduction in the irrigated acreage of a farming area. Scattered throughout the area are homes and improvements which in a few short years have decayed to the point where they are of practically no value. Here is a crumbling house that stands as a tombstone for one man's shattered dreams. Over there a few gnarled sticks arranged in orderly rows show where a vineyard used to be. A rusting pump of ancient vintage tells the story of one home owner who tried to supplement the artesian flow by pumping, only to be forced eventually to pack his belongings and join the trek out of the valley. Those tall trees rising from verdant oases in the distance mark the locations of artesian wells abondoned to spill their ever-decreasing streams onto the thirsty desert sands and form small, marshy, seeped areas.

By 1940 only about 400 acres were farmed in the San Simon Valley, and those were planted only to crops having a low-water requirement. Those farmers who weathered the storm endeavored to put their remaining resources to the best possible use. They sought and obtained the cooperation of such Government agencies as the Groundwater Division of the Geological Survey, the Soil Conservation Service, the Agricultural Extension Service, and the Rural Electrification Administration.

A program of water conservation measures to restore the artesian area has been recommended. This conservation would be accomplished by capping or plugging abandoned wells, by properly casing wells in use, and by restricting water withdrawals to the amount needed, taking cognizance of the physical limitations of the area as determined by the safe annual yield.

Plans have been laid for providing relatively low-cost power for the area. Soil conservation measures and crop programs have been studied. The farmers of the San Simon Valley have a difficult, but by no means insurmountable problem. By sound planning and good management they can eventually put their agriculture on a sustaining basis. This may be seen by the results already obtained. Today the irrigated acreage in the San Simon Valley is once more increasing and now totals about 1,000 acres.

However, the heartbreak and the tragedy suffered as a result of this agricultural decline during the past three decades can never be negated. They can only serve to emphasize the importance of sound, comprehensive planning, and the necessity for orderly development of potential irrigation projects.

NOTE.—The cooperation and assistance furnished by Messrs. S. F. Turner and H. R. McDonald of the Division of Groundwater of the Geological Survey, in the preparation of this article is gratefully acknowledged.

Bureau Sends Data on Masonry Dams to A. S. C. E.

In compliance with the request of a recently established subcommittee of the American Society of Civil Engineers, known as the Subcommittee on Uplift in Masonry Dams, the Bureau is making available a large amount of the technical data on the subject that it has collected over a period of years.

Photo by William S. Russell, Region III

The San Simon Valley is mute evidence of what happens through failure to unite in a soil improvement and erosion control campaign.

Sage-Growing in the Yakima Valley

Variety is the spice of life, and the postwar outlook for American-grown condiments is full of variables

by W. H. Farmer

Land Use Specialist, Region I, Boise, Idaho

Photo by H. Wayne Fuller, Region I

Irrigating field of sage by means of underground water system.

Time was when the sages of Yakima Valley were adding spice to the meals of America.

That was when sage-picking Yugoslavian goat herders along the Dalmatian coast became victims of the wartime shipping ban, dropping the United States' main source of supply to zero. Then it was that a dozen Yakima Valley farmers began raising commercial sage and other hard-to-get herbs and spices cut off by European shipping restrictions.

This planting of domestic or garden sage was concentrated mainly on the Bureau of Reclamation's Roza Division which was receiving its first water above Sawyer, Wash., in 1941 where experimental plantings were made. Shortly thereafter, the farmers began removing valueless native sage from virgin land and replacing it with its high-value cousin, *Salvia Officinalis*. In 1942 these farmers had formed a marketing organization, Sage Growers, Inc., and pioneered in large-scale sage culture. By 1944 the enterprise covered 100 acres.

The largest planting was that of E. C. Price and Cecil Clark who put sage plants on 25 acres of new Roza land. Others set out plants on tracts ranging in size from 1 to 11 acres. A combination of temporary wartime scarcity and excellent quality sent Yakima Valley sage prices soaring from their prewar low of 5 cents per pound in 1935 to $1 per pound in 1941. In 1943, the valley's first sizable sage crop brought 75 cents per pound for table sage yielding an average of 4,000 pounds per acre. By 1944 the price had dropped to 60 cents and in 1945 the growers were barely breaking even. The present price of European sage in our eastern market is between 20 and 25 cents per pound.

Commercial sage is a hardy perennial of the mint family, widely cultivated in gardens. Its growing characteristics and color resemble the native sage in many ways. Farmers say that sage is easily cultivated and will grow in any well-drained fertile soil in areas with a 180-day growing season and mild winters. Loss by freezing during the winter in the Yakima area was 5 to 10 percent.

For cultivation on a large scale the seeds are sown either in hot beds and transplanted or in field rows 2 to 3 feet apart. When the plants are well up, they are thinned to stand about 12 inches apart in the row. The original seedling plants had a tendency to produce narrow leaves so the Roza farmers selected broad leaved plants that did not flower so readily and produced a larger yield of leaves.

The sage affords a single harvest of leaves the first year, and two cuttings, one in June and one in October, beginning the second year. While cultivation and growing of sage is relatively simple, it is costly to harvest and process. After the first year, the plants bloomed profusely and the seed pods and stems had to be removed by hand before the harvest started. Harvesting is strictly a hand proposition, because the foliage must be kept free from dirt and older stem growth. Mexican nationals equipped with sickles and knives did the harvesting job for four cents per pound of green sage. Local hop kilns handled the curing process for the growers. Sage requires double the drying time of hops. It takes from 4 to 5 pounds of green leaves to make 1 pound of dry sage.

Removing stems from the sage leaves was a vexing problem until Walter Ludwig, resourceful Roza farmer, built a stemming machine in his farm workshop. The Ludwig machine took dried sage from the kiln, removed stray bits of soil and reduced the stem content to less than the 12 percent permitted by Government standards.

Packed for market in hop-size burlap bags, the sage was sold through the growers marketing organization in carload lots to a nationally known meat packing concern.

Admittedly, the sage growers had a war baby and a highly speculative crop. They kept individual acreages small and stopped production in 1946 when costs exceeded returns. A revival of sage production depends upon cheaper labor and improved machinery to compete with foreign imports. The domestic market is limited. During prewar years United States consumption was only 750 to 1,000 tons per year.

Peppermint as a farm crop has gained in popularity during the war years and Roza Division acreages have increased in 1946 over previous years. The latest available crop report for 1945 shows that 1,585 acres of mint were produced on the Roza, Sunnyside, and Kennewick divisions of the Yakima project with a value of $300 to $500 per acre.

Mint is propagated from young plants or by runners, similar to strawberry plantings. Its culture varies from that of other farm crops in two essentials. The water requirement is high and the crop must be kept weed-free to avoid off-flavors of the oil. Harvesting is similar to alfalfa, the crop being mowed and shocked. Peppermint plants contain the maximum amount of oil when they are in bloom so harvesting is done at that stage.

Other herbs and spices less well known to this northern latitude which were grown successfully by Yakima Valley farmers in a limited way include sweet Marjoram, Tarragon, Paprika, Basil, Thyme, Horehound, and Anise as condiments in food; Belladonna, Henbane, and Wormwood as drugs; and Tobacco for insecticides and stimulants. The wartime boom prices for these products has passed with the resumption of imports from Europe but a small group of Roza farmers still remember the fantastic prices received from their small plots for these herbs. From Bureau of Reclamation crop yield records on the Roza Division covering the period, 1942 to 1945 inclusive, we find the highest record per-acre yearly average values for all farms as follows: Sage, $2,170; Basil, $2,560; Marjoram, $1,500; Paprika, $8,050; Wormwood, $6,000; Belladonna, $1,600; and Henbane, $4,800.

AMARILLO'S WEATHER

"Howdy pardner—how's the weather in Amarillo?"

Everywhere an Amarilloan goes, that's the first question asked by those unfortunates who live in Washington, D. C., Seattle, Wash., Miami, Fla., San Francisco, Calif., or Newark, N. J.

Anyone but a native would imagine, upon hearing the question asked so frequently, that the United States Weather Bureau maintained its home office in Amarillo, cooked up all the vagaries of weather, and tried them out on the Plains before issuing the latest styles for use in other parts of the continent.

Some people don't care whether the weather in their locality is going to be fair, warm, cold, or indifferent. But let them come face to face with a citizen from Amarillo, Tex., and they can't wait until they get an opportunity to say, "How's the weather in Amarillo?"

If you reply that the weather is fine—lots of sunshine, cool nights, just enough wind to pump water for the finest cattle and horses ever coveted by an Oklahoma nester, the interrogator will shake his head sadly, slowly back off, and mutter something about "chamber of commerce" influence.

The wind **does** blow occasionally in Amarillo. Once in a great while you **can't** play golf in the winter. Some housewives **do** complain now and then because they have to keep putting blankets on the bed through the summer months while Washington, Chicago, Nashville, and Oskaloosa swelter.

Amarilloans are proud of the wind that blows across the Texas Plains. They know that it does something for people here that makes them grow bigger, live longer, burn up more energy, become handsomer and prettier, have better physiques, more brains, have larger bones and less fat, than the people in any other part of the country.

Gene Howe, Amarillo newspaperman, and noted columnist, is one of the greatest authorities on this subject of Amarillo weather.

Dust storms, which once in a great while come into this country from Colorado or North and South Dakota, Nebraska, and Kansas, are held by Gene Howe to be added blessings. He believes the dust contains vitamin K, a sure cure for anything that might ail a human being.

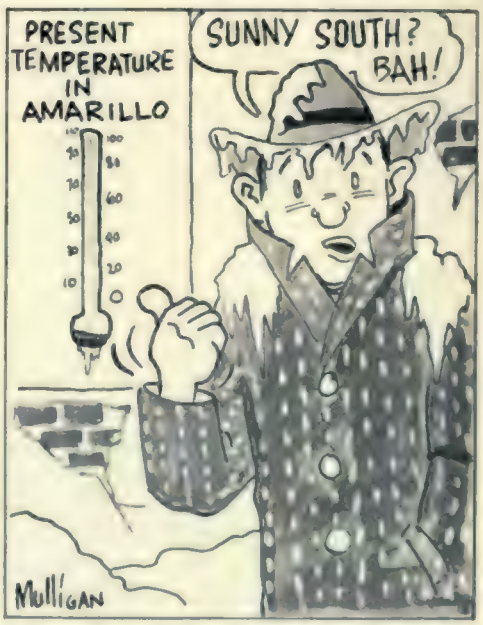
Another thing Amarilloans are proud of is their water. Hard water is known to have qualities that are much better for people than soft, slick water. Water with a punch in it; solid as concrete; that's the kind of water we have in Amarillo and we like it. Gene Howe believes our water has atoms in it. Perhaps it has. Anyhow, it's got what it takes.

Amarilloans don't take any stock in the story told by a newcomer here, who was engaged in the poultry business. This individual had a splendid flock of Black Minorca chickens. One day he whitewashed his poultry house. Suddenly the wind began blowing. It blew so hard that it swished the whitewash off the poultry house onto the Black Minorcas and made White Minorcas out of them.

Once in a while, but not nearly as often as we'd like, we get a light snow in Amarillo. If the wind happens to be blowing while its falling, a fellow might not be able to see the back of his neck, but that's hard to do at any time.

And every time we do get a belated snowstorm, some yokel from "the outside" laughs and laughs and laughs while telling about the old sourdough who started out from Amarillo to discover the North Pole. If you don't know the story, don't ask an Amarilloan.

How's the weather over your way, pardner?



Comparison of Climatological Conditions in Selected Cities of the United States

These data were made available through the courtesy of the Division of Climatological and Hydrologic Services, Weather Bureau, United States Department of Commerce

City—State	Average annual precipitation	Average hourly wind velocity	Average maximum temperature	Highest temperature of record	Average minimum temperature	Lowest temperature of record
	Inches	*Miles per hour*	*Degrees*	*Degrees*	*Degrees*	*Degrees*
AMARILLO, TEX	20.99	11.9	69.5	107	44.5	—16
Newark, N. J	47.14	10.2	61.2	104	43.7	—14
Miami, Fla	57.77	9.3	81.7	96	68.8	27
San Francisco, Calif	22.02	9.1	62.6	101	50.4	27
Seattle, Wash	34.03	8.8	58.6	100	45.1	3
Washington, D. C	42.16	7.3	64.4	106	46.4	—15

Hayden Lake Project Report Sent to Idaho Governor

The Bureau of Reclamation's report on improving the irrigation facilities of the Hayden Lake Irrigation District in Kootenai County, Idaho, and preserving the water supply has been approved by Secretary of the Interior J. A. Krug as his proposed report and sent to Governor C. A. Robins of Idaho. A copy of the report has also been sent to the Secretary of War. The Hayden Lake unit embraces an area of approximately 1,000 acres and is a part of the Rathdrum Prairies project. It is one of the units recommended in the Bureau's comprehensive Columbia Basin project report.

Record Purchasing of Columbia Basin Lands

Reports from Region 1 indicate that more than 12,000 acres of land were purchased by the Government for resale and settlement in the Columbia Basin project during the period April 1–15. This is the largest single acreage purchased during any single reporting period. Total acreage purchased to date is approximately 60,000 acres.

More Public Land Openings Planned

According to present plans the Bureau proposes to issue notices of the opening of public lands to homestead entry on four projects in the near future. The tentative number of units and estimated total acreage on the projects are as follows:

Project	Number of units	Total acreage
Gila, Ariz.	54	4,900
Riverton, Wyo.	68	8,000
Shoshone, Wyo.	31	5,400
Yuma, Ariz.	27	1,400

Lugert-Altus Project Renamed

The name of the Lugert-Altus project in Jackson, Greer, and Kiowa Counties, Oklahoma, has been changed to the W. C. Austin project in honor of the late Judge Austin (see December 1946 ERA), whose efforts helped in a large degree to make possible the construction of the project. This action was the result of the passage of Senate bill 214, which was signed by President Truman May 16, 1947. The project is designed to supply irrigation water for approximately 52,000 acres of land which have suffered from droughts in the past, control floodwaters, and supply municipal water to the city of Altus.

Divinity Limited

The banquet was in honor of an old settler who had played a major role in transforming the desert into a beautiful irrigated valley.

Said the toastmaster in lauding the honored guest:

"God and Art Smith turned this desolate waste into the prosperous community of irrigated farms and thriving cities that we have today."

The old man beamed.

When called upon to speak, he said calmly, yet seriously:

"It is true that God and I worked to transform the sagebrush waste into fertile irrigated farms. But God hadn't really done much with it until I got here."

Hospital Facilities Under Study

U. S. Public Health Service doctors have recently completed a study of the hospital facilities at Boulder City, Nev., to determine whether they are adequate to meet the needs of the community. A similar survey will be undertaken at Coulee Dam, Wash. Both studies were arranged at the specific request of Commissioner Straus.

Air Coordinating Committee

Archie B. Goodman of the Washington O. & M. staff will represent the Department of the Interior on the working subcommittee of the Interdepartmental Air Coordinating Committee. The ACC was established in September 1946 for the purpose of achieving the fullest development and integration of United States air policies and activities. It is comprised of representatives of Government agencies possessing a primary interest in aviation.

Savage En Route to Europe

Consulting Engineer John L. Savage recently left for Europe where he will be engaged as consultant on several large dam projects. He expects to visit France, Spain, Switzerland, and possibly Portugal. While abroad he will attend a United Nations conference at Geneva and upon his return will go to Mexico where he will consult with officials of that government on several dams.

Weed Research Program

(*Continued from page 158*)

cluded prevention of weeds in its program. This phase of the cooperative research activity can result in inestimable savings to farmers and irrigation districts on the Central Valley, Missouri Basin, Columbia Basin, and other new projects. Preventing new weeds from starting and old weed patches from spreading is also stressed on operating projects.

Most farmers know the losses they sustain when growing a crop on weed-infested land. These losses include: costs of weed control; increased cost of preparing the seed bed, cultivating, irrigating, harvesting, and marketing a crop; extra irrigation water; reduction of crop yield and quality; dockage; and reduction in land and loan values. Such losses seriously reduce the farmer's income.

Perhaps fewer people are aware of the weed problems which concern the irrigation systems. Noxious and other weeds on canal banks are a source of infestation to crop lands because the seeds are carried by the water. Weeds constitute one of the major problems of irrigation systems because they prevent proper inspection of the ditches; transpire enormous quantities of water needed for growing crops; prevent proper cleaning of the channels; and hinder the efficient delivery of water.

Water weeds reduce the capacity of canal channels making it difficult to deliver sufficient irrigation water; their desilting action necessitates costly dredging; and when they raise the water level, the result is loss of water through increased evaporation and seepage, erosion damage to canal banks, and often costly ditch breaks. Water weeds greatly impair the efficiency of drains which contributes to the water-logging of farm land and alkaline deposits in the soil.

The research program will be good news to both project farmers and irrigation district officials because it holds excellent prospects of helping change weed control from expensive but often temporary procedures to an orderly program based on economic, permanent, and scientific methods.

RECLAMATION READING

Miscellaneous Publications

A Program for American Forestry, by the Board of Directors, American Forestry Association, in *American Forests*, March 1947, page 104. Illustrated. This program of American forestry—formulated to meet the Nation's forest resource problem—has been submitted by the Board to its membership for adoption by referendum vote. (*American Forests* is published monthly by the American Forestry Association, Washington, D. C.).

Plan for Missouri Basin Includes Power Development, by Max Coffey, farm editor, The Omaha World-Herald, in *Rural Electrification*, February 1947, page 16. Illustrated. The author observes that in spite of wartime shortages in material and labor, public power has increased rural consumption of electricity in Nebraska fourfold in 5 years. (*Rural Electrification* is published monthly by the National Rural Electric Cooperative Association, Washington, D. C.).

Two Towns, by Angus McDonald, in *New Republic*, February 3, 1947, page 36. The author advances the theory that "large-scale, big-business, corporation, absentee-ownership farming is like a rotten apple that ruins the whole barrel" and describes the contrasting towns of Arvin and Dinuba, Central Valley, Calif., as proof.

Fourteenth Biennial Report of the Department of Reclamation, State of Idaho—1945–46 prepared by Mark R. Kulp, State reclamation engineer, Boise, Idaho. 126 pages. According to the report, due to satisfactory water supplies during the past 2 years controversies have remained at a minimum; and interest in water for mining purposes has increased. Cooperative investigations of the Department of Reclamation continue with the United States Bureau of Reclamation in irrigation investigations, with the United States Geological Survey in surface and ground water investigations, and with the Soil Conservation Service in snow surveys.

Comprehensive Plan for Columbia River Basin, in *Western States Reclamation Journal*, March 31, 1947, page 2. Illustrated. After careful consideration, Secretary of the Interior J. A. Krug, has given his approval to the plans of the Bureau of Reclamation for the most ambitious and comprehensive development of water and agricultural land resources for electric power and irrigation in history.

Cities Built on Water, by Miriam Roher, in *Western City*, March 1947, page 21. Illustrated. In the Colorado River Basin—an enormous, beautiful expanse 242,000 square miles large—40 cities and towns lie scattered, settlements flung over 7 of the United States. (*Western City* is published by the League of California Cities, Los Angeles, Calif.)

Engineering Publications

Available from the Design and Construction Technical Library, Bureau of Reclamation, Customhouse, Denver, Colo.

Principles of Leadership, by Col. John H. Carruth (P. O. box 66, Grayson Street Station, San Antonio, Tex.).—This booklet merits wide distribution not only among military personnel, but among the personnel of various organizations and individuals. Upon reviewing the book, the head of a large corporation ordered 3,000 copies to distribute to his supervisory employees. Cost: 1 to 200 copies, $0.50 each; 200 to 500 copies, $35.00 per 100.

Car Radio Static Reduced by Powder Blown Into Tube, in *Electrical World* (News Issue), April 5, 1947, Volume 127, No. 14, page 29, published by McGraw-Hill Publishing Co., 330 West Forty-second Street, New York 18, N. Y.—A powder that can be blown into automobile inner tubes to reduce static shock and car radio static will soon be available to motorists through certain tire distributors.

Static electricity is often evident to motorists through annoying clicks in their radios or through electric shocks they receive from the car doors when they step in or out of the car. This electricity is built up by the moving tires of the automobile and is affected by weather conditions and road surfaces, it was explained.

Realizing that the rubber tires prevent discharge of the static electricity to the ground, tire engineers developed the powder for application in the inner tubes of the tires. An air hose and a specially designed container are used to inject about one tablespoonful of powder into each tube after the tube has been deflated and its valve core removed.

The powder tends to cling permanently to the walls of the tube for the duration of the tube's life, modifying the electrical behavior of the tire and tube to eliminate or reduce static.

The powder was an outgrowth of research on conductive rubber tires for industrial trucks and tractors. Such tires were developed especially for munitions plants and other facilities where static electricity might easily cause fires and explosions.

Canal Lining Manual, by Carl Rohwer, Senior Irrigation Engineer, Soil Conservation Service, United States Department of Agriculture, November 1946.—From one-third to one-half of all the water diverted for irrigation is lost before it reaches the farmers' fields. Seepage from canals and laterals, leaks through structures, and evaporation and transpiration all help to dissipate the water supply. Control measures, which consist of treating the canal bed or lining it with other material, are described in this manual. (NOTE.—The above manual may be secured, in limited numbers, from United States Department of Agriculture, Soil Conservation Service, Division of Irrigation, College Hill, box D, Logan, Utah.)

My Experiences As a Ditchrider

(*Continued from page 159*)

charge rather than the depth of water over the weirs. The total discharge for any period of time could be rapidly determined with a planimeter.

This is the first irrigation system in northern Colorado, as far as I know, to work out an effective method of furnishing irrigation water on demand and for storing it when not needed. The method has demonstrated its worth through continued use for 50 years.

My experience as ditchrider gave me broad knowledge of the difficulties confronting farmers growing crops under irrigation, of the importance of water in the semiarid and arid regions of the West, of the urgent need of better methods of measurement and distribution of irrigation water, of improved methods of irrigation, and the value of storage and of conservation of our water resources.

The salary helped pay my way as a student in the Colorado State Normal School and University of Colorado, and ditchriding later proved good basic training for a college president.

Adams Tunnel Dedicated

As water began to follow its man-made itinerary through the 13-mile Alva B. Adams tunnel, it heralded the beginning of benefits to the population of the Big Thompson and South Platte River Valleys, and climaxed a near miracle of engineering.

On June 23 record breaking crowds gathered on both the eastern and western sides of the Continental Divide as the crop-saving irrigation water began to trickle from the Pacific slope of the Rocky Mountains to the Atlantic slope where it will provide supplemental irrigation for more than 600,000 acres of inadequately watered lands.

The dedication was marked by the attendance of many notables including Under Secretary of the Interior Oscar L. Chapman, State Governors and members of the congressional delegations from Utah, Wyoming, Nebraska, Kansas, and Colorado, and Commissioner Michael W. Straus who delivered the principal address of the evening. Others in attendance included Mrs. Alva B. Adams, widow of the late Senator Adams for whom the tunnel, key feature of the Colorado-Big Thompson project, was named because of his tireless efforts to equalize the supply of water on both sides of the Continental Divide.

U. S. GOVERNMENT PRINTING OFFICE: 1947

NOTES FOR CONTRACTORS

Contracts Awarded During May 1947

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1638	Missouri and Columbia Basins.	May 1	5 gate assemblies for Angostura, Long Lake, and Potholes Dams.	Willamette Iron & Steel Co., Portland, Oreg	$64,727.00
1652	Central Valley	May 15	Electrical equipment for Shasta and Keswick switchyards' schedules 1, 2, and 6.	General Elec. Co., Denver, Colo	470,606.20
1652	do	do	Electrical equipment for Shasta and Keswick switchyards' schedule 3.	A. B. Chance Co., San Francisco, Calif	93,337.28
1652	do	May 7	Electrical equipment for Shasta and Keswick switchyards' schedule 4.	Southern States Equipment Corp., Hampton, Ga	45,018.72
1652	do	do	Electrical equipment for Shasta and Keswick switchyards' schedule 5.	Westinghouse Elec. Corp., Denver, Colo	25,502.40
1663	Boise and Colorado-Big Thompson.	May 12	Hollow jet valves and accessories	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	194,948.00
1668	Boise-Payette	May 1	Construction of Conway Gulch lateral and "C" line East Canal.	Humphrey-Ketchen Co., Boise, Idaho	251,381.00
1677	Rio Grande	May 6	Electrical equipment for Alamogordo and Hollywood substations' schedules 3, 6, 7, 10.	General Elec. Co., Denver, Colo	49,365.74
1677	do	do	Electrical equipment for Alamogordo and Hollywood substations' schedules 4, 5.	Electric Power Equipment Co., Philadelphia, Pa	14,328.83
1701	Yakima-Roza	May 16	Motor control equipment for various pumping plants.	Wolfe & Mann Manufacturing Co., Baltimore, Md.	15,300.00
1711	Boise-Payette	May 21	Clearing part of Cascade Reservoir site	Wixson & Crowe, Redding, Calif	288,720.00
1712	Rio Grande	May 9	Construction of spillway alterations at Elephant Butte Dam.	J. H. Ryan, Albuquerque, N. M	65,115.00
1718	Davis Dam	May 20	125-ton gantry crane and auxiliary trolley	Judson Pacific-Murphy Co., Emeryville, Calif	144,325.00
1719	Deschutes	May 1	Construction of Willow Creek Siphon and Wasteway.	Morrison-Knudsen Co., Boise, Idaho	195,161.00
1734	Davis Dam and Colorado-Big Thompson.	May 23	9 governors for turbine regulation	Woodward Governor Co., Rockford, Ill	230,990.00
1740	Colorado-Big Thompson	May 9	4 pumping units for Granby pumping plant	F. H. Whiting Co., Denver, Colo	19,750.00
1741	Davis Dam	May 16	Control board for Tucson substation	General Elec. Co., Denver, Colo	13,771.00
1742	Central Valley	May 21	50 residences for Antioch and Tracy Government camps.	Green Lumber Co., Laurel, Miss	131,480.00
1743	Hungry Horse	May 19	Clearing part of Hungry Horse Reservoir site	J. J. Reese, Columbia Falls, Mont	408,320.00
1751	Central Valley	May 13	Radial gates and hoists, schedule 2 and 3	Pacific Coast Engineering Co., Alameda, Calif	19,396.00
1753	Scofield	do	Clearing part of Scofield Reservoir site	Burks & Co., Denver, Colo	20,000.00
1757	Deschutes	May 15	96-inch diameter steel pipe for Willow Creek siphon.	Pacific Coast Engineering Co., Alameda, Calif	68,436.00
1766	Shoshone-Heart Mountain.	May 28	Construction of Ralston lateral and sublaterals' schedule 1.	Askevold Construction Co., Missoula, Mon	208,959.00
1766	do	May 27	Construction of Ralston lateral and sublaterals' schedule 2, 3.	Sharrock & Pursel, Casper, Wyo	253,091.50
E-33,090-A-2	Central Valley	May 14	Treated and untreated lumber	Niedermeyer-Martin Co., Portland, Oreg	58,686.99
1707	do	May 23	2 aluminum accordion doors, one aluminum sash window.	Seattle Bronze Co., Seattle, Wash	34,000.00
1710	Colorado-Big Thompson	May 1	Two 72-inch outlet pipes for Horsetooth dam outlet works.	Thompson Pipe and Steel Co., Denver, Colo	55,270.00
1722	Missouri Basin-Kortes	May 22	3 bulkhead gate-frames and 3 storage supports for Kortes Dam, item 2.	American Bridge Co., Denver, Colo	17,204.00
1726	Mirage Flats	May 23	Sand and coarse aggregate	L. R. Olson, Gering, Nebr	11,019.20

Construction and Supplies for Which Bids Will Be Requested During July 1947

Estimated date to be invited	Estimated date bids to be opened	Project	Description of work or material
July 1	Aug. 5	Boulder Canyon, Nevada	Laying 6 miles of 12- and 14-inch diameter high-pressure steel pipe, and erection of 50,000- and 2,000,000-gallon storage tanks for Boulder City.
Do	do	Central Valley, California	Materials for Elverta-Tracy 230-kilovolt transmission line (75 miles).
Do	do	Colorado-Big Thompson, Colorado	Materials for Loveland-Greeley transmission line (30 miles).
Do	do	Columbia Basin, Washington	Control and station service boards for Grand Coulee pumping plant.
Do	do	do	Unit substations and exciter switchgear for Grand Coulee pumping plant.
Do	do	do	Station service 6,900-volt switchgear and 460-volt power distribution boards, station transformers, battery control and distribution equipment, and battery chargers for Grand Coulee right powerhouse.
Do	do	Missouri Basin-Boysen, Wyoming	Generators for Boysen power plant.
Do	do	Missouri Basin-Kortes, Wyoming	Ring-follower gates for Kortes Dam and power plant.
July 7	Aug. 11	Missouri Basin-Boysen, Wyoming	Turbine and governor.
July 12	Aug. 15	Austin (Altus), Oklahoma	Construction laterals and structures for irrigation of 10,000 acres of land.
July 15	Aug. 19	Colorado-Big Thompson, Colorado	Surge tank for Granby pumping plant.
Do	do	do	50-ton and 75-ton cranes for Estes Park and Marys Lake power plants.
Do	do	Columbia Basin, Washington	Earthwork and structures, West Canal station 405 to 1213.
Do	do	do	Earthwork and structures, Potholes East Canal, station 0 to 436.
Do	do	do	Construction of 12,000-foot Soap Lake siphon. Concrete, 25-foot diameter; steel, 23-foot diameter.
Do	do	do	Concrete canal lining and structures, Main Canal, station 751+94 to 1100+90.8.
Do	do	do	Pumping plant bus structures for Grand Coulee pumping plant.
Do	do	do	De-icing motor-generator sets for Grand Coulee power plant.
Do	do	Davis Dam, Nevada-Arizona	Crossarms, conductor, and conductor hardware for the Tucson-Cochise transmission line.
Do	do	Missouri Basin-Angostura, South Dakota.	50- by 30-foot radial-gate hoist, Angostura Dam.
Do	do	Missouri Basin-Frenchman-Cambridge, Nebraska.	Two 60-inch hollow-jet valves for Enders Dam.
Do	do	Missouri Basin-Kortes, Wyoming	60-ton crane for Kortes Dam and power plant.
Do	do	Palisades, Idaho	Materials for Palisades-Goshen 115-kilovolt transmission line (55 miles).
July 16	Aug. 20	Klamath-Tule Lake, Oregon-California	Construction pumping plants G, H, J, K, I, M—capacities 7 to 15 cubic feet per second.
July 25	Aug. 29	Davis Dam, Arizona-Nevada	Erection and installation of cableway and gaging station, Davis Dam.
July 28	Sept. 2	Central Valley, California	Excavation, concrete footings, and gravel surfacing for Keswick switchyard.
Do	do	Columbia Basin, Washington	Pumping units for Burbank pumping plant.
July 30	Sept. 3	Colorado-Big Thompson, Colorado	Siphon No. 1, Horsetooth Feeder Canal.

Photo courtesy of the Utah Centennial Commission

Monument to Progress

Here is the artist's conception of "This Is the Place" monument, which will be unveiled on July 24, 1947, climaxing the Utah Centennial celebration. The monument is located at the mouth of Emigration Canyon overlooking the Salt Lake Valley and was sculptured by Mahonri M. Young. It is comprised of 15 separate statues and groups aggregating 30 tons of bronze. It has been designed to commemorate the explorations and activities of white men in the Intermountain region from the advent of Catholic padres in 1776 to the coming of Brigham Young and his pioneers in 1847.

Vol 33 no. 8

AUGUST 1947

Featuring:

●

The stories of two Reclamation tunnels, the oldest and newest

●

LAND SPECULATION
by
Assistant Secretary of the Interior
WILLIAM E. WARNE

●

Does Beekeeping Have a Part in Reclamation Planning?
by
James I. Hambleton

Public Library,
Kansas City, Mo.

THE Reclamation ERA

Nelson Named Assistant Commissioner

Krug Congratulates Nelson

Wesley R. Nelson, Regional Director of Region V, and a reclamation engineer with many years' experience, was sworn in as Assistant Commissioner of the Bureau of Reclamation on July 1. Secretary of the Interior J. A. Krug, who was present when Mr. Nelson took the oath of office, stated that Mr. Nelson has the complete support of the Secretariat of the Department of the Interior and the Bureau of Reclamation. He commented on Nelson's past performance in difficult assignments and said that it was because of his ability to cope with such situations that he was chosen for the job. Nelson in reply expressed his appreciation for the Secretary's belief in his integrity and ability and said that he would do his level best to merit the confidence placed in him through this appointment. He succeeds William E. Warne, who took the oath of office as Assistant Secretary of the Department of the Interior, on the same day.

Prior to joining the Bureau in 1922 as chief of a survey party and junior engineer on the Grand Valley project, Nelson was part owner and manager of an irrigated cattle ranch in Colorado. He left the Bureau to work for private engineering firms in 1927, returning in 1931 as assistant engineer and later as associate engineer during the construction and until the completion of Hoover Dam.

Subsequently Nelson was transferred to Washington, D. C., to head up the Division of Engineering. In this capacity he served as a member of various technical and policy-making committees representing the Department of the Interior and the Bureau of Reclamation. During his stay in the Capital he was associated with some of the very first groups studying proposals for river-basin development.

As Regional Director it was his responsibility to direct and coordinate all Bureau activities in Texas, Oklahoma, a part of Kansas, most of New Mexico and the San Luis Valley in Colorado. He supervised and directed project planning, marketing of hydroelectric power, gave administrative assistance to the officials of the districts in charge of operating projects and assumed general responsibility for projects under construction.

Mr. Nelson was born at Norwood, San Miguel County, Colo., and attended the Universities of Colorado, and Southern California. He is a graduate Cum Laude, B. S. in civil engineering of the latter named institute. He is married and has been making his home in Amarillo, Tex.

H. E. Robbins succeeds Nelson as Acting Regional Director. He is a career engineer of thirty years' service and was in charge of the Valley Gravity Project when appointed.

Reclamation ERA

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Ruth F. Sadler, *Editor*

Our Front Cover

Symbol of Thrift and Industry

A close-up of a bee at work. Frequent visits from pollinating bees aid the continued growth of these fragrant blossoms and other forms of plant life. Photo was taken by Philip Merritt, Region I. See story on page 181.

The RECLAMATION ERA regrets to announce the sudden death of T. W. Parry, irrigation adviser at McAllen, Tex., who passed away shortly after his arrival in Washington to attend a conference. His loss will be mourned by a host of friends made during his many years with the Bureau.

A REPORT ON RECLAMATION

by EDWARD J. CLEARY

Executive Editor, *Engineering-News Record*, New York City, N. Y.

Returning recently from a reconnaissance of reclamation projects in the Southwest, I found on my desk in New York an invitation from the editor of the RECLAMATION ERA to submit a brief report on my observations. Being a reporter for a technical journal, my first impulse was to comment on the engineering and construction features of the work visited. But I found myself possessed with another—and even stronger—desire. And that was to give some expression to what might be termed the "personality" of the Bureau as revealed by its staff.

Impressed as I am with the achievements of the Bureau which are manifested in steel and concrete, I find myself even more profoundly stirred by the spirit that typifies the men and women who work for the Bureau.

Here are people who take great pride in the work they are doing. Each one seems to display a personal responsibility for maintaining and enhancing the prestige of his organization. And this responsibility is discharged with such friendliness and good will that obviously it is a natural response and not simply an assumed attitude.

What can be the explanation of this *esprit de corps*, this loyalty and conscientiousness, that distinguishes the personnel of the Bureau?

Among other things, it must stem from the knowledge in the heart of every employee that he is playing an essential role in an unusually constructive enterprise. Regardless of the position he holds, the Bureau employee cannot help but identify himself as a builder. A builder, if you please, in the business of creating new empires; and a member, incidentally of an organization that has traditions of sound public service dating back almost half a century.

Furthermore, being in the happy position of knowing that the result of his efforts eventually finds expression in some tangible form such as a dam, a power house or a canal, there comes with this a genuine feeling of solid accomplishment. Simply to look upon the flowing water that converts desert wastes into green fields and to know that you have had some part in making this possible, is an experience that must provide tremendous satisfactions.

These, I believe, are some of the reasons why the Bureau of Reclamation is staffed with people whose attitude stamps them and their work as of a highly superior grade.

My recent experience with scores of employees in Regions III and V confirmed—

and strengthened—earlier impressions received in other regions of the bureau. In my every contact I have found that the reclamation employee is enthusiastic about showing what he is doing, eager to describe how he is doing it, and competent in his explanation of why it is being done.

The exigencies of travel being what they are, there have been occasions when my schedule of job visits intruded on evening off-hours or week-end holidays of project personnel. But if I wanted to see and talk about reclamation activities—which I did—there was no lack of cordial cooperation in making this possible.

That this attitude is an integral part of Bureau of Reclamation staff philosophy should be evident to even the most casual visitor at any of the projects, but notably so at Hoover Dam. Hundreds of visitors are accommodated daily at this monument to engineering skill. The courteous manner in which they are received and conducted about, and the way in which explanations are given and questions answered is a convincing demonstration of public relations exercised by those who know the real meaning of public service and take satisfaction in its practice.

In devoting so large a part of this brief report to what might be termed the "personality" of the Bureau of Reclamation, I am not unaware of its physical accomplishments. In both size and scope, the projects conceived by the Bureau have by their very boldness stirred the imagination of people throughout the world. And it is also apparent that in the translation of these projects from dreams to reality, courageous private contractors have been inspired to revolutionize many aspects of construction practice.

Not so much in the public view, but nevertheless one of the most vital operations of the Bureau is that which is conducted under the rather prosaic title of engineering laboratories.

Based on the simple premise that no structure can be any better than the materials that go into it, there has been developed what is probably the world's greatest research organization in the field of civil engineering and construction.

Over the relatively short span of 17 years in which these laboratories have been operated there have come findings that have had a profound influence on the improvement of engineering practice. More tangible, perhaps, is an appraisal of the laboratories' accomplishments in terms of dollars' and cents' saving on reclamation projects. This is estimated to have reached the astounding sum of $20,000,000!

How these savings have been achieved is dramatically illustrated in connection with the selection, utilization and control of concrete materials. Among other things, these studies have resulted in obtaining concrete of required quality with one-tenth barrel less cement per cubic yard than was heretofore considered possible. Since some 30,000,000 cubic yards of concrete have been put in place under these specifications, the resultant saving is estimated to be $6,750,000. Equally spectacular from a monetary point of view was the redesign of the Grand Coulee spillway based on laboratory findings and which is said to have cut costs on this item alone by some $5,000,000.

A visit to the engineering laboratories of the Bureau in Denver provides a singular opportunity to learn how the skills of the engineer, the geologist and a host of other scientific specialists have been coordinated to improve reclamation practice and otherwise aid in the advancement of technical knowledge.

Like many others, I feel it a happy privilege to be a witness to the work of the Bureau, and in so doing associate with a group of men and women whose competence is exceeded only by their devotion to the task in hand.

United States Department of the Interior

J. A. Krug, Secretary

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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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Region I: R. J. Newell, Regional Director, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho. Region II: R. L. Boke, Regional Director, Box 2511, Old Post Office Building, Sacramento, 10, Calif. Region III: E. A. Moritz, Regional Director, Administration Building, Boulder City, Nev. Region IV: E. O. Larson, Regional Director, 32 Exchange Place, P. O. Box 360, Salt Lake City 8, Utah. Region V: H. E. Robbins, Acting Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex. Region VI: K. F. Vernon, Regional Director, Stapleton Building, P. O. Box 2130, Billings, Mont. Region VII: Avery A. Batson, Regional Director, 501 Continental Oil Building, Denver, Colo.

Do You Plan To Move?

If so, please notify the *Reclamation Era* so that you may continue to receive your copy regularly.

Letters to the Editor

THANK YOU, SENATOR CAPPER

Washington, D. C.
June 10, 1947

Dear Mrs. Sadler:

I have just received the June issue of your very interesting magazine, *Reclamation Era*. I hasten to send my sincere congratulations. You may well be proud of this very attractive magazine. I have no doubt it will be a success in every respect.

Cordially yours,

Arthur Capper,
United States Senate,
Chairman of the Committee on Agriculture and Forestry.

The Bureau is doubly appreciative of this comment, coming as it does from a busy statesman and well-known publisher of midwestern papers, who along with all his many other official duties found time to commend a Government publication dealing with the problems of reclamation farmers.

An Easterner's Appreciation

One Mountain Avenue,
Maplewood, N. J.,
May 28, 1947.

Dear Editor: Accept my appreciative thanks for your memorandum of May 23 and for the accompanying photographic prints and copies of the Reclamation Era.

It is going to give me a great deal of pleasure to make use of the material that has been sent me so that the public and the world at large will have a still better grasp of what the Bureau of Reclamation is doing to turn the dry lands of the country into richly productive and profitable areas for the benefit of the nation as a whole. With kindest regards,

Yours sincerely,

Robert G. Skerrett.

Reader Skerrett's request dealt with irrigation developments and particularly canal construction on the Friant-Kern canal and in the Columbia River Basin. The Era is gratified to note the widespread interest by people of the East in Western reclamation activities.—Ed.

Among Widtsoe Fans

Logan, Utah.
June 2, 1947.

Dear Mrs. Sadler: Please send me one dozen copies of the May Reclamation Era, together with statement of cost.

I am especially interested in the article by Dr. John A. Widtsoe entitled "A Century of Irrigation." Thank you kindly.

Yours very truly,

O. W. Israelsen,
Research Professor of Irrigation & Drainage.

College Caliber

Route 2, Box 142,
Denver 7, Colo.

Dear Editor: We have been highly pleased with the Reclamation Era. The articles have been well written, the pictures clear and distinct, the plans and progress data full and well arranged.

Our daughter uses it as material at the University (Denver) for class discussion and enlightenment, clearing up misunderstandings as to work and plans of Reclamation.

Enclosed is check for a Five-Year Subscription.

Sincerely,

Henry H. Nicholson.

NEXT MONTH

"Owyhee Reservoir" the story of a Reclamation "Fisherman's Paradise," in the Northwest, by Lyle M. Nelson, formerly Assistant Regional Information Office at Boise, Idaho. ALSO an account of how Reclamation Safety Engineers have contributed to the decrease in accident frequency on construction jobs. The difference between the number of accidents when the Gunnison Tunnel was constructed and the number during the construction on the Alva B. Adams Tunnel.

Name	*Address*

"Get Acquainted" Copies

If you have friends or associates who would be interested in the *Reclamation Era*, please list their names and addresses in the box to the left, clip and send it to the Commissioner, Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues so that they can get acquainted with your magazine.

EAST *Meets* WEST

Photo by Thompson, Region VII

A view from the top of East Portal, Alva B. Adams tunnel, of the first water coursing through during the dedication ceremonies.

By Vaughn Mechau

Region VII, Denver, Colo.

Contrary to Mr. Kipling, the East and West can meet.

They met on June 23 when, with Nature's process reversed, snow waters from the high country of the Colorado River in western Colorado rolled under the towering 14,000-foot Continental Divide and out upon the fertile foothills of eastern Colorado.

The occasion was the first diversion of Colorado River water through the 13-mile-long Alva B. Adams Tunnel of the Colorado-Big Thompson project of the Bureau of Reclamation.

It was a long-awaited day—a day of celebration.

The first flow of water, which will later reach large proportions to nourish 615,000 acres in northeastern Colorado, is the realization of a pioneer dream.

In 1889, the first proposal for such a diversion was made in the Colorado Legislature by Representative Hiram Prince. It required years of need and necessity before Representative Prince's hopes began to materialize. Not until 1935, through the untiring efforts of the late Senator Alva B. Adams, was the Bureau of Reclamation allotted funds to make surveys and prepare plans for bringing water to eastern Colorado.

During the 10 years before the Colorado-Big Thompson project was begun, farmers of the irrigation area to be served suffered approximately $47,000,000 in crop losses because of late summer water shortages. The irrigation district, once considered the wealthiest agricultural section in the world, suffered great losses.

Under the plan, Green Mountain Dam was first to be constructed to insure irrigators on the Colorado River of no loss of water from the diversion to eastern Colorado. The dam was built on the Blue River, a tributary of the Colorado, to hold the spring floods or release water as needed.

The perplexing problems of driving a tunnel under the Continental Divide for the diversion of water were next to be solved. Engineering skill, perseverance, and plain, dogged tunneling put through the granite divide of the continent the longest tunnel in the world driven from two headings.

When the job was completed it had been not only one of the safest tunnel jobs on record but the closure was within seven-sixteenths of an inch perfect on line and three-quarters inch on grade. It was an engineering feat that amazed engineers whose only standard was perfection.

Work on other functions and facilities followed. But the need for water was great. A temporary diversion was agreed to following serious crop losses last year as a result of the almost-annual curse—lack of water for maturing crops. Five of the irrigating companies of the northern Colorado water conservancy district, the agency contracting with the Government, raised $110,000 to construct a 38-inch pipe line for delivery of water.

Completion of the pipe line and diversion

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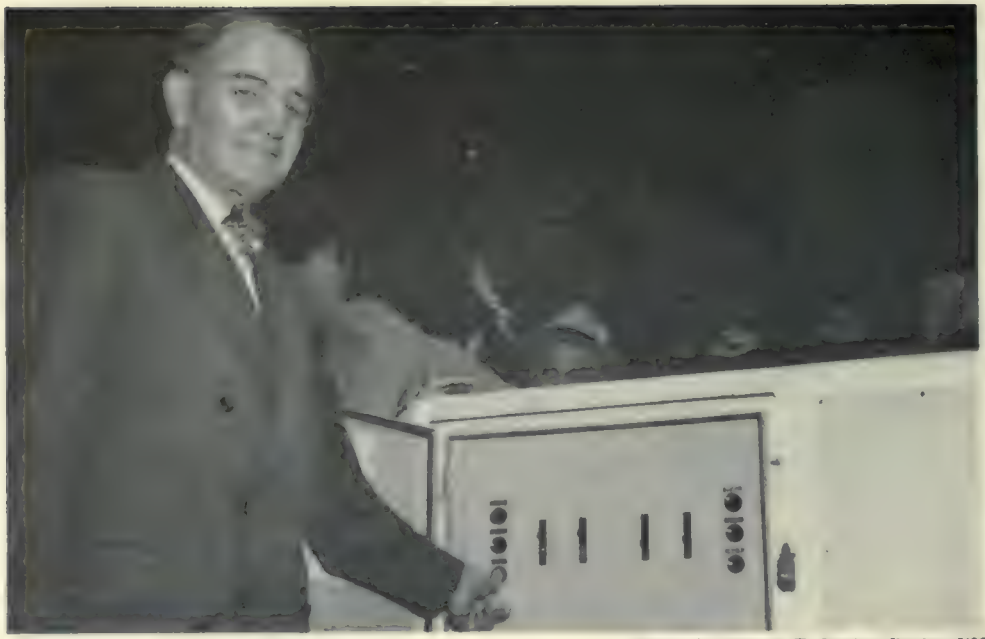


Photo by Norton T. Novitt, Region VII

Governor Lee Knous of Colorado pushing the button that opened the Adams Tunnel gates for the first flow of water from western to eastern Colorado.

of life-giving water was sufficient reason for a celebration. The idea swept the foothills country like wildfire.

Promptly at 10:30 a. m., George Field, chairman of the Grand County Commission, opened the proceedings at the west tunnel portal. A thousand persons—among them growers of fine Hereford cattle, hay growers, resort owners, "fancy Dan dudes,"—looked out over Grand Lake, a natural body of water, and its sister lake, Shadow Mountain Lake.

Carl G. Breeze, representing Colorado River water interests, told the group:

"This day, this very hour marks a new and significant period in Colorado's irrigation history . . . I am referring to the meeting of minds and the understanding that exists between two different groups in order that both mutually benefit so that the State and Nation will benefit."

Colorado's Governor, Lee Knous, followed. With newsreel cameras grinding, Governor Knous rammed the red button with his thumb and the gates slowly lifted.

"There it goes," went up from a thousand throats.

Governor Knous and his party then raced the water across the Great Divide. They cut across Trail Ridge Road, one of the highest automobile highways in the Nation, snowbound the night before but cleared by rotary plows, enabling the Governor to keep his appointment at the east portal.

About the time Governor Knous was pushing the button at the west portal, on the east side of the divide, at Estes Park, the planning and construction of the project was being outlined at a luncheon by Chief Engineer Walker R. Young, Project Engineer C. H. Howell, and former Supervising Engineer Porter J. Preston. The group then convened at the east portal of the Adams Tunnel to await the arrival of the Colorado River water. Spectators crowded the hillsides.

Governor Knous' transmountain tour ended at the east portal prior to the arrival of the water. Oscar Chapman, Under Secretary of the Department of the Interior, handed to him a special communication from President Harry S. Truman, which the Governor read to the assemblage. In his letter the President congratulated the people of Colorado and the engineers responsible for the project and predicted that it would bring continual wealth and prosperity to the West.

Following the Governor, J. M. Dille, secretary-manager of the northern Colorado water conservancy district, spoke on "The District and the Project." He was followed by Judge Clifford H. Stone, director, Colorado water conservation board, whose subject was "The State and the Project."

Under Secretary of the Interior Oscar L. Chapman, who had participated in the holing-through of the Adams Tunnel and had signed the contract between the district and the Government, then began his address.

Hardly had his first sentence been spoken when a distant voice proclaimed, "Here she comes!" Voices picked up the phrase, "Here she comes," and all eyes were focused on the first roily serpent of water to course its way from the tunnel mouth, 3 hours after the west gates were lifted, exactly as scheduled by the Bureau.

As the crowd quieted, the Under Secretary's voice could be heard, saying:

"With this first diversion of water, the Alva B. Adams Tunnel is being put to its intended use. When other engineering works of the whole Colorado-Big Thompson project, of which the Alva B. Adams Tunnel is a part, have been completed, it can do its full job and serve more than 300,000 acre-feet of water to more than 600,000 acres of land, thus insuring full crop production.

"Because the waters drop about 2,900 feet on the eastern slope—22 miles from the Continental Divide—they produce a high potential for the generation of power. Sale of power that is in excess of irrigation pumping needs will not only service a large area but it will provide funds for repayment of a major portion of the presently estimated $128,000,000 construction costs.

"It is estimated that almost 1 million people in this region will share in project benefits. It is also estimated that the gross return to farmers and to processors of crops and livestock in the area will be increased by $21,150,000 annually. If we consider the returns for 40 years—this increase will amount to $846,000,000 in values of agricultural products.

"In addition to these, the power revenues are expected to total $151,700,000 during the repayment period. Recreational benefits will add $12,720,000 in this length of time. Thus, the total benefits from the Colorado-Big Thompson project over the repayment period will exceed $1,000,000,000," Mr. Chapman concluded.

By now the dream of Colorado River water in eastern Colorado had become a reality. The retaining dam below the portal was backing up more and more water and the thousands could see for themselves the life-giving liquid.

That night, at the closing banquet in Loveland's fine community building, Commissioner Michael W. Straus sounded a prophetic note:

"A lot of people will be watching because this is one of the great water projects of the world. If it fares well and fulfills its promise, the rest of the plans—the plans that will move forward for almost a century in both the Missouri Basin and the Colorado Basin—will proceed. If it fails, the plans will falter and the hopes of many of your neighbors will be dashed.

"Cherish and preserve this project. It is a project of all the people—all the people of the valley and all the people of the Nation. Let no man abuse it. Watch your property, keep up your canals and ditches, maintain your gates and drains, guard and protect it and, in turn, in dry seasons and in times of drought and dust, it will guard and protect you."

The dreams and concrete efforts of man were dedicated June 23, and the celebration, now over, opened a vista of security and insurance against the vagaries of nature.

Accidentless Month at Davis Dam

A recent report from the Personnel Safety Engineer's office shows that there were no lost time accidents on the Davis Dam project during the month of April. This marks the first accident-free month since the construction began on the project in April 1946.

WELCOME
GUNNISON TUNNEL OPENING.
1909
Montrose County POTATOES 1909 WORTH $225.000. WITH GUNNISON WATER THE CROP OF 1910 SHOULD BE $1.000.000.00
CATTLE AND SHEEP SHIPMENTS BROUGHT $450.000 TO THE COUNTY LAST YEAR
WE DO NOT HUNT THE MARKETS THE MARKETS COME TO MONTROSE THE FRUIT CROP OF 1909 IS WORTH $450.000 AND NOW MOVING 1910 HAVE 700 ACRES OF NEW BEARING ORCHARD

Archway erected at Montrose, Colo., in honor of the late President William Howard Taft who personally attended the tunnel celebration.

Holing Through in 1909

The Story of The Gunnison—Reclamation's First Major Tunnel

By G. J. Van Gieson

Branch of Design and Construction, Denver, Colo.

September 23, 1909, was a balmy Indian Summer day on the western slope of the Continental Divide in Colorado.

There was no wind in the Uncompahgre Valley as the sun shone brightly on 900 residents and visitors who had gathered to celebrate an auspicious occasion—the opening of the Gunnison Tunnel. The big moment of the day came at precisely 5:18 p. m. when President William Howard Taft touched a golden plate with a silver bell to release a flow of water through a 6-mile bore to the thirsty Uncompahgre Valley.

Earlier in the day the Presidential Special—a narrow-gage train especially fitted for the occasion—churned its way through the Rocky Mountains and came to a stop outside the city of Montrose at the outlet portal of the tunnel. Here the Presidential party was met by a blaring brass band, a delegation of Spanish American war veterans in colorful campaign uniforms, and the cheering citizens of the valley.

The fanfare marked the end of the first step of a construction job that was as full of romance and tragedy as many of the sagas of the Old West. The driving of the Gunnison Tunnel was indeed a pioneering achievement in the annals of western reclamation development. The bore was driven 6 miles through granite, quartzite, gneiss and shale, and layers of sandstone, coal, and limestone, first by manual labor, then later with power equipment. In the early stages of construction, candlelight was the only illumination. During the course of construction, 26 men lost their lives and over 100 suffered serious injuries.

Some of the first information about the Uncompahgre Valley came from explorations made by Capt. J. W. Gunnison in 1853 who declared it was a desert, "unfit for cultivation and inhabitable only by savages." At that time the territory was inhabited by the Ute Indians. In 1881, the Utes were removed to Utah and the following year, the Denver & Rio Grande Railway was constructed through the center of the valley. Settlers came with the "iron horse" in hopes of making the area an important agricultural center. It was supposed by these early settlers that the Uncompahgre River would supply an abundance of water, and large irrigation canals were constructed. However, it soon became evident that the water to be obtained from the Uncompahgre would not adequately irrigate the lands.

L. C. Lauzon, a farmer who had formerly been a miner, told the people of Montrose that he dreamt of a tunnel to carry water from the Gunnison River into the Uncompahgre Valley. The Gunnison flowed through a rugged, unexplored canyon to the east of the Valley and was separated from it by a mountain range 2,600 feet high. Whether the dream part is true or not, it is certain that Lauzon first conceived the idea of the tunnel and for many years afterward the proposal was known as "a farmer's dream." After several years, Lauzon's idea took hold and a public subscription was secured to pay for surveys. The people of the valley were desperate for an adequate water supply. The idea received the early support and untiring backing of the late Congressman John C. Bell and the Uncompahgre Valley Water Users' Association, which was formed in 1903.

Investigations showed the Gunnison River flowed through the Black Canyon at an elevation higher than the Uncompahgre Valley and a plan was evolved for the gravity diversion of water from the Gunnison by a tunnel 6 miles in length and a canal approximately 12 miles long to supplement the flow of the Uncompahgre River. In 1901, the Colorado legislature appropriated $25,000 to locate and construct a tunnel.

Work was begun on driving a tunnel in December but was suspended in the fall of 1902 when funds were exhausted after driving 900 feet.

In 1902, the Reclamation Act was passed by the Congress and the following year the Colorado Legislature authorized the conveyance of the tunnel property and rights to the Reclamation Service. Within a few months, the Uncompahgre Valley water users approved a repayment contract with the Reclamation Service for construction of a tunnel and in 1903 the diversion plan was approved by the then Secretary of the Interior, Ethan Allen Hitchcock of Missouri.

The tunnel started by the State was abandoned and a new site chosen 5 miles up the Gunnison at Boat Landing Gulch. This was done because further investigations by Reclamation Service engineers revealed that the length of the tunnel could be shortened and more land irrigated. In January 1905, the Taylor-Moore Construction Co. of Texas was awarded a contract for the construction of the tunnel and began work at the new site. The company threw up its contract in May and turned the work back to Reclamation Service engineers when it was unable to fulfill its obligations. At this point both a consulting board and the Uncompahgre Valley Water Users' Association recommended that the tunnel be completed with Government forces. As soon as approval was received, the Reclamation Service immediately took over construction.

The first serious accident occurred in the tunnel at 9:55 a. m. on the morning of May 30, 1905, just 3 days after the Reclamation Service began construction. Timbering in the heavy ground at the west portal gave away, burying ten men and imprisoning 19 others between the cave-in and the heading of the tunnel. Rescue work started immediately. Twenty-one men were taken out through a shaft sunk from the surface on the morning of May 31 and 8 others were rescued on the following day. Of the 29 men involved in the accident, 23 were rescued and 6 perished.

In 1906, in a premature explosion at the east portal, two men lost their lives and one had his eyes blown out. Tragedy struck again in 1910 when 13 miners were overcome by powder smoke in the tunnel which resulted in the death of 9 of the men.

Notwithstanding these and other accidents, work continued apace on completion of the tunnel, despite unexpected engineering difficulties. Prior to the commencement of work in the tunnel, it was believed that difficulties from water seepage would be relatively small. In December 1906, work was halted for 6 months on the west end when a seam was encountered carrying warm water and carbonic gas. Because of the extreme heat and the strong flow of gas it was physically impossible to continue work until a ventilating inclined shaft was sunk to supplement the existing pipe ventilating system.

In April 1908, a water flow was tapped at the east end which stopped all progress in the heading for months and was overcome only after the pumping mains had been increased by the addition of 10-inch pipes and additional pumps. The tapped water vein produced a flow of from 8 to 10 second-feet in the tunnel, about 4,000 gallons per minute.

For over 2,000 feet the tunnel was driven through a geological fault zone which brought about a weird and unholy assortment of grief. Working in a saturated atmosphere at a temperature above 90° F., the miners were obliged to exercise the utmost caution to prevent fatalities. The Uncompahgre Valley project history reports, "At frequent intervals rushes of water would break through from the sides or face, carrying in hundreds of yards of sand which buried tracks, tools, and everything else within 500 or 600 feet of the heading."

A flash flood in July 1908 washed away a temporary dam at the west portal, flooding the west end of the tunnel and the portal cut. Timbers were washed out and from 10 to 14 feet of sand and gravel were deposited in the portal cut. At the time of the flood, 30 men in the bore were forced to make their escape through an inclined shaft about 9,000 feet from the west portal. It was almost a month before a complete investigation of damage could be made. Other than the damage already mentioned, it was found that approximately a mile of track had been overturned, and silt was deposited on the floor of the tunnel for a depth of 2 to 4 feet for a distance of three-quarters of a mile.

When work was first started at the Gunnison Tunnel, all drilling was by hand. One miner would hold a heavy drill and rotate it as a second miner whanged away at it with a sledgehammer. It took husky, hard-working men to do the drilling. Muck was removed in cars on tracks but with a horse for motive power instead of an electric or gas engine. Some months after construction began, power plants were installed at each end of the tunnel, thus permitting the use of compressed-air drills and other power equipment.

New construction records were set on the Gunnison Tunnel despite the many difficulties encountered. One gang of miners, working in three shifts, drove 7,500 feet in 12 months. Two world's records were set in boring through granite and shale. In a single month a record 824 feet of heading advance was made through shale. The record for granite was 449 feet in a month.

Not the least of the hair-raising adventures that occurred many times every day was the transportation by wagon-teams of all supplies and equipment over the mountain to the east end of the tunnel. Tough,

(Continued on page 182)

At left, the night shift at Gunnison takes time out for a photograph. Time—1905. Note tallow candles, only source of illumination in the tunnel. At right, the Reclamation office force at Lujane, Colo., in 1907. Left to right are James L. Luney, Harry Essley, and the Misses Nellie Cummings, and Nancy Shackleford.

The Problems of a Project Manager

All photos by Philip Merritt, Region I

At left, Forest Sower, Manager of the Boise Board of Control, inspects the gauge on the New York Canal. At center, he is seen checking a section of the canal, one of the main canals of the 320,000-acre development. At right he is talking it over with dragline operator Carl Hamilton. Good public relations are only a small part of his job.

By Elma Hill Neal

Like the old Roman god, Janus, who was supposed to be able to look more than one way at once, is the manager of an irrigation project.

He is generally a graduate engineer with an education that enables him to cope with men and handle situations that require a fine technical discernment. Yet he must be a human sort, too, who has not lost the common, practical touch, and is sympathetic with the vexatious problems of all the farmers down to the one on the tail end of the ditch. He must be familiar with tomes of irrigation law, for there is hardly any irrigation project to date that has not fought its way to the top through a torment of legal confusion.

He must have a reserve supply of administrative ability, based if possible on experienced appreciation of the multitudinous duties of employees. He must be a good public relations man, able to deal fairly with water users and their innumerable requests, and with labor, both organized and unorganized.

While the snows are still lying deep in the cold blue canyons among the Teton peaks and are glistening white along the high ridges of the Sawtooth Range, the project manager is making plans. He is carefully checking reports on snow depths. He is calling his ditchriders together for conferences. He is making plans that include coping with drainage difficulties, as well as assuring the efficient delivery of water. He is sizing up the labor situation, scanning the field for capable men as ditchriders.

His mechanics are busy with dragline, tractor, and truck, getting the last spark-plug cleaned and the last nut and bolt in place. As soon as weather permits, he and his men are going over the big ditch, foot by foot, inspecting riprap and linings, looking for faulty headgates and weathered concrete works. He knows what fill is sandy and has to be watched, what section is favored by the gophers as summer homes, the exact bend in the canal that is subject to swirls of silt. He lays a campaign of strategy as exact as that of a general, and when the first gurgle of mountain water hits the dry bed of the main canal, all is ready.

The fact that he is reasonably sure that all is well, does not keep him from being mentally alert at all times. There is a tenseness in the atmosphere that is felt even in his home, for the job of project manager is a 24-hour job during the water season, with minutes stolen for eating and sleeping. Often when sweet Morpheus has the man soothed for a brief time, the far-off distant ringing of a phone brings him instantly wide awake, for the fear of a break in the canal is ever in the back of his mind.

His wife lays plans, too, that include dinners which will keep fairly palatable, for he is usually delayed. The morning and evening meals are hectic, constantly interrupted by the jangle of the phone or the heavy knock on the door. Everybody who can crowd into the old Ford goes with Dad to watch the water come down, and young and old feel the excitement and thrill of "water in the ditch."

Breaks may occur at any time, but are most likely in the beginning of the season. But the project manager has prepared for this contingency, too. Some canal outfits have a "break trailer" loaded with shovels, canvas, and other necessary equipment to be hooked onto a truck in a moment.

One of the most melancholy sights that I have ever seen occurred years ago on a raw May evening. A young manager, newly assigned to a run-down irrigation project, stood on the torn edges of a high fill that had broken out. Dark water poured out of a huge ragged gap. He had done what he could. A lot of the supply had been diverted at the nearest point, but there was the water, vital to the life of the land, flooding out over the low farms, drowning a fine field of alfalfa seed, spreading out over young wheat to a damaging depth. He stood helplessly watching, and I knew he was thinking of the crops farther on down the canal that would soon parch for need of the water wasting at his feet.

He was not alone long. Men and teams with scrapers were in the canal almost before it was safe, bringing up dirt and rocks and filling in the great breach. People came for miles around to stand and peer in the darkness of the chilly night. Bonfires were built for warmth and light, and women brought kettles of coffee and baskets of sandwiches to stay the men who worked so feverishly, and sweat and swore in the muck at the bottom of the ditch. The manager did not sleep that night nor yet the next day. But before 24 hours had rolled around, obvious headway had been made in the rebuilding of the destroyed bank. This youthful manager had learned overnight the principle of cooperation on a grand scale and friendly sympathy of farmer for farmer—priceless talismen on which project managers depend for added strength and skill.

By mid-July the flush of the floodwater has passed. The canal banks have settled. Moss grows long and green and slimy in the bottom of the canal. It waves gracefully in the gentle current and takes up a lot of space that could be filled with water. Men with tractors drag great links of chain down the canal, scraping up ropes

(Continued on page 182)

LAND SPECULATION

National Archives photo

"SPECULATORS WHO BOUGHT THE LAND BEFORE IT WAS IRRIGATED MADE FORTUNES. . . ."

by William E. Warne
Assistant Secretary of the Interior
Formerly Assistant Commissioner of Reclamation

Land speculation in the early years of the national reclamation program came very close to ruining it.

Seldom did the first settlers in the land boom era receive the benefits of Government expenditures on irrigation. Speculators who bought the land before it was irrigated made fortunes instead.

The settler was the victim. He paid the speculator a price which not only included the value that the Government had added by the construction of irrigation works, but often the value that the settler himself would have to add by patient husbandry over the years. On top of that, he had to borrow the money for the purchase from the bank a high rate of interest.

The farmer, who could not figure out how he had been hoodwinked, staggered under the load for a few years and went down. The next man who attempted to carry the obligations fastened upon the land often went down also. They could not understand how the Government could be so hard as to press for repayment of the money it had invested for them in the irrigation project, and they sent their spokesmen to camp on the trails of the Congress, seeking relief.

Looking backward, the destructive aspects of land speculation on Federal irrigation projects are clearly delineated.

Speculation plagued Reclamation for 20 years after the Reclamation Act was passed in 1902. The framers of the act thought that they had found an adequate way of dealing with the speculation problem when they inserted the acreage limitation provision. After hard experience and a series of investigations, more effective speculation controls were added, but still they were entwined with the acreage restrictions.

A number of boards of enquiry, appointed by Secretaries of the Interior and by the Congress, and one committee after another of the Congress itself investigated. They found that speculation brought disaster to the actual settlers on project land, jeopardized the Federal investment in the projects, and delayed the orderly settlement of the projects. As a result, through the years, the Congress added provisions calculated to put teeth into the control of speculation in project lands. For more than 20 years these controls have proved effective.

The history of the fight against speculation in Reclamation project lands reveals why the Congress has written safeguards into the law.

Early Land Booms

Away back in 1913 the Reclamation Service became alarmed by wild land speculation on the 25 projects which it had initiated up to that time. Project engineers and managers were asked to report what the value of unimproved land had been prior to construction of each project and what that same unimproved land was being sold for in 1913 at the time of the survey. The results of that survey are shown the table on pages 178 and 179.

It shows that as of 1913 the average price of unimproved land had increased by 759 percent on the 25 projects studied. This tremendous increase in the price of land took place quickly. For 11 of the projects, only 7 years had elapsed since construction began. Two other projects had been in existence only 6 years; another for 5 years; and another only 1 year. For 4 others, 8 years had elapsed; and another 4 had been started 9 years before the survey was made. Only 2 projects had had a life of 10 years.

Speculation varied considerably from project to project. On the Tieton division of the Yakima project, Washington, the prices of unimproved land increased by almost 5,400 percent; on the Minidoka project, Idaho, 1,525 percent; on the Okanogan project, Washington, 2,400 percent; and on the Shoshone project, Wyoming, 5,000 percent.

What was happening to the value of land that was not affected by Federal expenditures for irrigation and reclamation in these same States? The facts are shown in the table on page 179 indicating that from 1905 to 1913 the value of all lands in farms in the 11 Western States increased by only 110.8 percent, compared to the dizzy heights reached on the reclamation projects. The greatest increases in values of land occurred in the States of Arizona, Montana, and Washington, where they amounted to 227, 150, and 125 percent, respectively. In New Mexico the increase was as low as 37 percent during this same 8-year period.

These data prove that speculators were cashing in on the Government's expenditures for irrigation projects.

This was the era when the deprecating remark gained currency that "it takes three crops of settlers to make a successful irrigation project." Nearly everyone of the original settlers who bought into projects at such inflated prices found it impossible to make a go of it. There is a great difference in the real worth of unimproved, dry land and that of developed, irrigated land, but the difference is made up of two principal elements. One of these is the labor of the settler who must construct his farm ditches, clear and level his land, and plant and raise his first crop. The other is the construction cost of the project which is charged against the land, and, although the terms are generous, must, nevertheless, be repaid to the United States. The settler who bought in at boom prices found he still had these two factors against him, although often he had paid prices that were as high as a debt-free, improved, irrigated farm should bring.

Public and Private Lands Involved

The experience of those early days demonstrated that it is not enough simply to place a limit on the amount of land for which

"Land speculation in the early years of the National Reclamation Program came very close to ruining it"

"THE FARMER . . . STAGGERED UNDER THE LOAD FOR A FEW YEARS AND WENT DOWN."

any one landowner might receive water. When that fact had been adequately demonstrated, the Congress added in 1926 the anti-speculation teeth to the law. The factors contributing to the speculation are clear.

Public Lands

Almost as soon as surveys were commenced in an area, it would become known that a Federal Reclamation project, perhaps involving the expenditure of millions of dollars, was in the offing. Immediately, filings would begin on public lands for homesteads, even though everyone knew that it might be years before the irrigation water could be delivered.

It was a frailty, later corrected, of the original act of 1902 that, although the public lands could be withdrawn for Reclamation purposes, the law did not at the same time prevent the filing for homesteads. Premature entry and settlement occurred, largely by those bent on speculation.

The minority report of the Senate Committee on the Irrigation of Arid Lands in 1911, which looked into this problem, and the Director of the Reclamation Service, in his eleventh Annual Report, pointed out that homesteaders were frequently able to demand high prices for relinquishment of their title to later bona fide settlers, or to the Government, which often had to purchase rights of way through the same lands for canals after the surveys that touched off the boom had been completed. These relinquishments were sold as high as $100 an acre and more, though the lands remained dry.

Thus the second comers to the project lands, who were the real farmers, had terrible burdens. Not only must they clear and level the land and prepare the soil, while building their houses and barns, and not only had they to pay for the construction of the works, but they also had to shoulder the burden of paying from 8 to 12 percent interest (in those days) on the unearned increment in the inflated prices which the speculators had charged for the land. Many such settlers, in fact, lost their farms to the third comers to the land, thus giving color to the "three crop" derision.

As a result, the Congress in the act of June 25, 1910 (36 Stat. 836), section 5, provided that no entry should be thereafter made and no entryman permitted to go upon lands reserved for irrigation purposes until the unit of acreage per farm unit and water charges and date of delivery had been fixed and publicly announced.

In addition, the Bureau of Reclamation, under powers still later conferred, has devised methods for selecting the settlers on public lands to keep out those whose sole interest might be that of land speculation.

Today there is no speculation in public lands of the projects.

Private Lands

It is not generally understood that the Reclamation Act of 1902 provides for the irrigation of both public and private lands. At first, it was believed that mainly public domain would be involved. At the very outset, however, the advantages of the areas where part of the land was already in private ownership were vigorously pressed and, in many instances, these locations did afford greater opportunity for the development and settlement of a project than could be found in areas composed exclusively of public domain.

Some of the early projects included only privately owned land, and on nearly all of the projects there was a considerable proportion of private land. More than one-half of all the lands included was privately owned at the time the projects were authorized, and about two-thirds of all lands under water contract with the Government in 1924 were in private hands by the time water was ready for delivery on the projects.

After the owners of these private lands agreed to divest themselves of their holdings in excess of the permissible 160 acres, there was no way in the early days of Reclamation to prevent the placing of any extravagant price on the excess land.

Some prices were so high as to prevent the purchase and settlement of projects.

The Fact Finders Report, made in 1924 by a distinguished group of men appointed by Secretary of the Interior Hubert Work to look into the problems of irrigation and reclamation, contains many instances of these private lands being sold to settlers at prices that proved unbearable.

The effects of these "land-boom" prices for project land seriously jeopardized the economic feasibility of the projects. Again and again the settlers came to Washington or sent their representatives to plead for a reduction in their construction charges, to seek to postpone their payments, and otherwise to seek relief so that they could continue to farm the project land. In many instances this resulted in breaking down the repayment principles and the program.

In many areas, land prices rose to such heights that bona fide farmers passed the project by. This slowed down the settlement and development of the lands, which also postponed the date when water users could begin to repay construction charges. Canals without customers became the order of the day on some projects.

Speculators in these ways defeated to a large extent the economic and social purposes of the Federal, interest-free expenditures for irrigation projects.

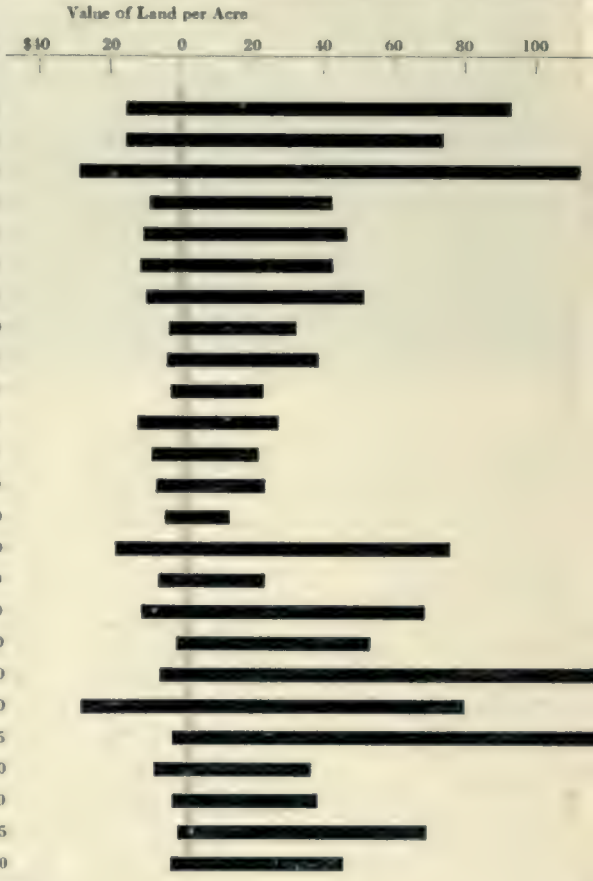
The Fact Finders Committee and also the Congress, as evidenced by the passage in 1926 of the Omnibus Adjustment Act, believed that the owners of excess land should be required to sell that land at prices which represented its actual value regardless of the proposed construction of the irrigation works. Section 12 of the Reclamation Extension Act of 1914 (38 Stat. 689) and section 46 of the Omnibus Adjustment Act (44 Stat. 636) so provide, and section 46 also provides that these restrictions on the price at which such land may be sold are to hold until at least one-half of the construction charges against the lands are paid.

Fortunately, the record has been sufficiently preserved, as a result of testimony before congressional committees and through reports to permit careful summarization by projects of all salient details on land speculation. A project-by-project review leaves no room for doubt of the

HOW SPECULATION I

FOR UNIMPROVED LAND ON RECLAMATION PROJEC

State	Project	Number of acres	Date construction began	Before construction began
ARIZONA	Salt River	240,000	1903	$17.50
ARIZONA-CALIFORNIA	Yuma	90,160	1905	17.50
CALIFORNIA	Orland	14,000	1908	29.00
CALIFORNIA-OREGON	Klamath	30,908	1906	10.00
COLORADO	Grand Valley	53,000	1912	10.50
COLORADO	Uncompahgre	140,000	1904	11.50
IDAHO	Boise	30,000	1906	11.25
IDAHO	Minidoka	132,000	1904	2.00
MONTANA	Flathead Indian	138,000	1907	7.00
MONTANA	Huntley	28,835	1906	4.00
MONTANA	Milk River	251,906	1906	12.50
MONTANA	Sun River	16,397	1906	10.00
MONTANA-NORTH DAKOTA	Lower Yellowstone	63,603	1905	10.00
NEVADA	Newlands-Truckee-Carson	206,000	1903	6.00
NEW MEXICO	Carlsbad	20,073	1906	25.00
NEW MEXICO	Hondo	10,000	1904	10.00
NEW MEXICO-TEXAS	Rio Grande	175,000	1906	17.50
OREGON	Umatilla	20,240	1906	5.00
WASHINGTON	Okanogan	10,000	1906	10.00
WASHINGTON	Yakima-Sunnyside	100,000	1906	32.50
WASHINGTON	Yakima-Tieton	34,000	1907	2.75
NORTH DAKOTA	N. Dak. Pumping, Williston	12,097	1906	11.00
SOUTH DAKOTA	Belle Fourche	100,000	1905	4.00
WYOMING	Shoshone	131,900	1904	1.25
WYOMING-NEBRASKA	North Platte	129,239	1905	5.00



TOTAL ACRES INVOLVED 2

AVERAGE INCREASE IN LAND VALUES PER ACRE . . . . .

need for speculation controls on Reclamation projects. I shall not try to cover all projects, but will give a review of some that are typical.

Rio Grande Project

Construction began on the Rio Grande project, New Mexico-Texas, in 1906, but as the plans were developing, the prices for the unimproved desert land had risen by that year to $15 or $25 an acre. In 1913, only 7 years later, the prices of this same unimproved land had risen to $50 and $75 an acre. In February 1916, the Central Board of Review, discussing certain recommendations for project development, said:

> About three-fifths of the American lands under this project are held by owners in comparatively large areas, so that the greater part of it is excess land which must be sold. From the best information obtainable, much of this land was not bought for the purpose of making homes, but for the purpose of reselling it at a profit to actual settlers. The prices at which it is being held are so far above the original cost as to make this a serious obstacle to development. In other words, it is an attempt to collect from the actual settler all the advantages of the Government's expenditure in the way of enhanced prices. This is a more serious obstacle than project costs.

In explaining the failure of the project lands to be settled completely, in spite of extensive promotional activities, the president of the Elephant Butte irrigation district stated in a report to the Board of Survey and Adjustment that:

> The reason is that even the most unthinking and inexperienced would-be farmer is wise enough to know that he can't clear, level and build up the fertility where leveled, crop his farm, feed his family and pay the tremendous overhead.

He was referring to the amortization and interest charges on land purchases and irrigation construction cost charges when he referred to "overhead."

In discussing what action should be taken with respect to a plea from the water users to reduce the construction charges against the land, the Board had this to say:

> It will, however, only add to the injustice and wrong to the ultimate actual user of water on this project if the project cost is reduced now, because the benefits will not go to the settler but will be appropriated by the speculative owner.

The Board advocated immediate action to protect the bona fide settler against loss of time and money through a program to warn prospective farmers of the total land and water charges they would have to face if they undertook to purchase at the then inflated prices. The Board also recommended that the Government purchase the land and settle it under a system of organized aid and direction, with low interest rates and long-term credit such as was being done in Australia. This plan was adopted in 1943 for the control of speculation on the great Columbia Basin project.

Salt River Project

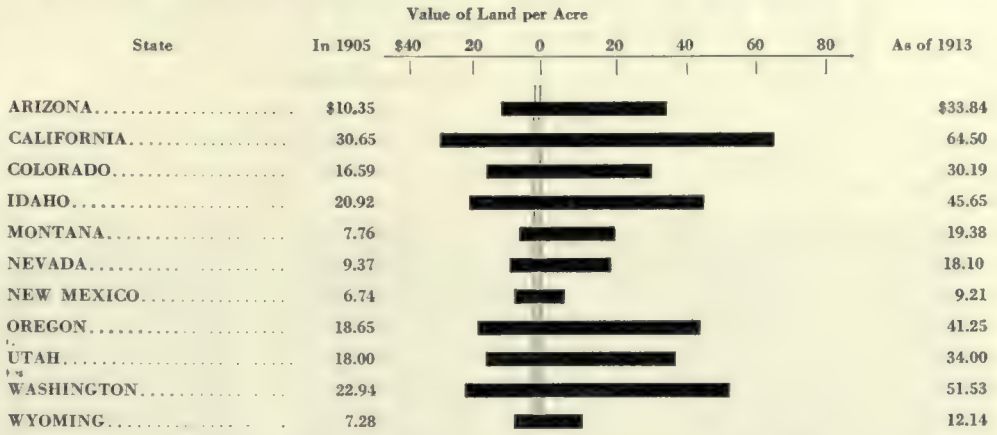
Construction began on the Salt River project, Arizona, in 1903. Of the land originally included in the project area, only about 16,000 acres were public lands.

Some of the private holdings, such as those held by the Chanler Land Improvement Co. and Messrs. Murphy and Fowler, were large. A typical land boom was unleashed at the time the project was begun. Land changed hands rapidly, with increases of from $5 to $10 an acre between each sale. Finally, the eventual settler was faced with the impossible job of earning enough to pay high interest rates and amortization on his land, and construction charges as well.

A few farmers in the Valley had gained a virtual monopoly on truck farming at the time, and most of the settlers could not afford the long development period required to get citrus trees into production. This became the sole prerogative of a few wealthy landowners. Most settlers were restricted

EASED LAND VALUES

ON ALL FARM LANDS IN ELEVEN WESTERN STATES



AVERAGE INCREASE 110.8%

practically to the planting of alfalfa. Until 1914 there had been a good market for alfalfa in the Los Angeles area, but then the crop began to be grown in Southern California. All this led to serious financial consequences for the settlers.

In 1913 the project engineer reported that by the time construction began 10 years before, the price of unimproved desert land had risen to $17.50 an acre. Seven years after construction began, this same unimproved land was selling for an average of $92.50 an acre, an increase of 440 percent. Much of it was disposed of at from $200 to $300 an acre, and some that was close to Phoenix proper sold for $500 an acre.

The effects of this speculative rise in unimproved land prices, both on the settlers and on the repayment prospects of the project, were described by the then Director of Reclamation, Mr. F. H. Newell, during hearings before the House Committee on Irrigation of Arid Lands on January 27, 1912:

> The water users on the project believe that important concessions in making repayments are necessary, especially in the case of the numerous settlers who have recently come to the valley and who have purchased lands at a high price and which are now heavily mortgaged. These men are struggling under a debt with large interest charges and will, of course, have great difficulty in making prompt payments to the Government for water if they consider the real estate dealer or former owner of the land as a preferred creditor. They figure about this way: A man has bought land at about $150 an acre and has paid, say, a tenth down, with interest at 8 percent on the remainder. Supposing thus that he now owes $120 an acre, next year he must pay 8 percent on this $120, or $9.60 an acre, and must pay a tenth payment of $15 more, or $24.60 an acre, and must support his family in addition. He therefore arrives at the conclusion that he cannot afford to pay the Government. He forgets that it is the water furnished by the Government which alone gives value to the land. There is constantly before him the fact that the rich Government does not need the money and may be put off, while at the same time he believes that the money lender or man who holds the mortgage on his property cannot be thus held off.
>
> The existence of this class of landowners, namely, those who have bought at high prices and are loaded with debt, constitutes the main argument in favor of concessions regarding payment and leaves the Government with the alternatives—
>
> First, enforce payment at the rate of one-tenth each year for 10 years. This, it is stated, will send many of the small landowners to the wall, as they cannot keep up their payments to their creditors and maintain the high rate of interest and support their families if in addition they must refund to the Government.
>
> Second, grant such concessions in the way of extension of time or graduated payments as will enable these debt-burdened landowners to succeed, thus placing the Government in the attitude of waiting while the original holder or speculator collects the earnings of the settler.

Yakima Project—Tieton Division

Construction on the Tieton Division of the Yakima project in Washington began in 1907. Apparently speculation on the lands in this area did not begin before construction as it had on many other projects, for the project engineer reported that large blocks of unimproved land within the project area had sold at $0.50 to $5 per acre (the average was $2.75). After the construction was started, the prices of unimproved land advanced to from $100 to $300 an acre. Many tracts were sold to prospective settlers at these inflated prices.

Okanogan Project

Values of unimproved land on the Okanogan project, Washington, before the construction of the project began in 1906, had reached about $10 an acre. Shortly, they soared and by 1913 unimproved land was being sold for from $250 to $300 an acre. Loose, sandy land on what is locally known as "The Flat" was selling for $75 an acre in 1913. Land with 3- or 4-year-old orchards was selling from $400 to $525 an acre at that time, although the early flush of speculative prices was reported to be falling off somewhat by then.

Commenting on the general conditions on the project in 1913, the project supervisor stated:

> Poverty here as elsewhere has undoubtedly in many cases rendered the best (agricultural and irrigation) methods impossible, due to cost. It is thought that these hard times being experienced will continue for two or three years on this project, and within that time considerable fruit will undoubtedly be shipped, and the growth of other crops will also aid materially. The speculator will have to sell by that time to some bona fide farmer and at such a price as will make it possible for the buyer to live. The high prices of land and over-speculation have undoubtedly caused the stagnation which is affecting the entire country at present.

The speculative story on these projects was more or less the same as those of others which had been undertaken up to 1913 when the survey was made.

Repayments Jeopardized

These case histories indicate that the farmers' ability to carry their repayment obligations for the irrigation construction charges was lessened by the speculation. By 1923 the situation had become so acute that the Fact Finders Committee was appointed by the Secretary of the Interior to see what should or could be done. The Secretary reported that as of December 31, 1922, $6,000,000 of construction and operation and maintenance charges were due and unpaid by the water users.

The committee studied each project. Again and again in its report, the Committee commented on the important part which land speculation had played in creating the conditions that it found. The following statements in the report are typical:

> The greedy owner of private lands, ready to trade upon the natural desire of vigorous, hard-working men, for independent homes, should and could have been squelched.
>
> * * *
>
> Of great importance also in explaining the difficulties of the Reclamation Service, is the failure of the original act to provide such control over the rights as to acquire at the time of each transfer a proper proportion of increased value to be

paid on construction charges. As a result existing construction charges have been ignored when transfers were made, thus leaving the last purchaser burdened with the increased land value as well as the construction cost. This combined burden of indebtedness made it difficult and in some instances impossible for the settler to meet his annual obligation to the Government.

The table on this page shows that in the main those projects on which the greatest amount of speculation occurred in their formative years had, a few years later, the most delinquency. The delinquency on projects which had had relatively little speculation was negligible.

One example: the Shoshone project, on which the value of unimproved land increased by 5,000 percent from 1904 to 1913, had in 1923, 23.7 percent of construction charges due and unpaid.

Little speculation took place on the Newlands and Carlsbad projects. Between 1903 and 1913, the prices of unimproved land on the Newlands project, Nevada, increased by only 108 percent, little more than the increase of 93.2 percent in value of all farm land in the State. In 1923, only 4.5 percent of the construction charges were unpaid on the Newlands project. Similarly, on the Carlsbad project the value of unimproved land rose 170 percent from 1906 to 1913, and its unpaid construction charges in 1923 were only 8.3 percent.

While the correlation shown on the figures in this table between speculation and delinquency is not perfect, and there were undoubtedly other factors which influenced delinquency, there can be no doubt that in 1923 the early speculation in project lands still adversely affected repayments and the projects.

The delinquencies in construction, and operation and maintenance, payments have been greatly reduced, the latter entirely eliminated, since 1926, when teeth were put in the speculation controls.

The provisions in the Omnibus Adjustment Act of 1926, calling for the securing of recordable contracts from owners of excess land, have been applied on many Reclamation projects since that time.

Vale Project

On the Vale project in Oregon, begun 20 years ago, recordable contracts were signed with owners of excess land for the entire excess acreage on that project. The owners since have disposed of all of this excess land. The average price at which that unimproved land was sold was $10 per acre. This took place since 1926, when the present law was enacted, and is in sharp contrast with the earlier history.

Owyhee Project

On the Owyhee project, Oregon and Idaho, a new project, recordable contracts were secured for approximately 12,500 acres of excess land. The excess land was mainly in the ownership of two large land companies, the Eastern Oregon Land Co. and the Oregon and Western Colonization Co. Both companies executed recordable contracts and disposed of the excess land over a period of several years. These excess lands were sold at the appraised price established by the Secretary of the Interior. The average appraised price was slightly less than $10 per acre. In the case of each sale, the agent of the company and the purchaser joined in an affidavit to the irrigation district setting forth the sale price.

An additional 5,000 acres in the Gem and Black Canyon irrigation districts on the Owyhee project were excess land owned by the State of Idaho. The State sold its land under its usual procedure of advertisement and auction to the highest bidder. Some of these lands were sold for as high as $25 per acre, by contrast with the procedure on the other lands. The Secretary ruled that a purchaser of State land within the Gem or Black Canyon irrigation districts might obtain a water right upon the execution of a separate contract with the United States which required the application to construction charges of one-half of any increment in price above the Secretary's appraised price from the sale of these lands to a second owner. Purchasers of State lands all executed these separate contracts.

Deschutes Project

On the Deschutes project, Oregon, there were excess lands in the Jefferson water conservancy district. Recordable contracts for 98 percent of this excess land have been obtained—and approximately 40 percent has been disposed of at appraised prices varying from $23 for Class 1 land to $20 for Class 3 land. Irrigation is just starting on this project, which is getting off to a good beginning.

Minidoka Project

On the Minidoka project, Idaho, recordable contracts were obtained for 100 percent of the excess land in the American Falls Reservoir district No. 2, and to date 6,738 acres, or 94 percent, has been disposed of at an average appraised price of between $25 and $30 per acre, depending on the class of land.

Columbia Basin Project

On the Columbia Basin-Grand Coulee Dam project, Washington, 4,659 recordable contracts have been signed by owners of 988,950 acres of land on this, the largest Reclamation project. This represents 79.3 percent of the entire acreage and more than two-thirds of the 6,748 owners of the project. The average appraised value for land on this project is $10.54 per acre. Irrigation cannot begin for several years, since large canals are yet to be completed. In general, there has been understanding and support for the acreage limitation and anti-speculation provisions of the law on this project.

The present law works. The speculation controls of the Omnibus Adjustment Act of 1926 have functioned successfully on later projects and have prevented speculation. Other examples could be given.

Land Prices and Repayment Ability

In determining the economic feasibility of proposed projects, a determination is required of the ability of farmers on the lands to repay all or parts of the costs of construction that are allocated to irrigation. A number of budgetary studies for various types and sizes of farms which either exist now or will exist on the various projects have, therefore, been made. These studies take into account all factors which enter into returns from agricultural production and the legitimate costs of securing that production, including family living costs. They usually arrive at an amount designated in Reclamation parlance as the "Return to Water," which is indicative of the farmer's ability to pay for construction out of his farm activity. This is usually expressed in both per-farm and per-acre ability to repay construction costs.

Consideration is given in such analyses to the farmer's capital investment in land and irrigation structures, and a cost item of 5 percent is usually set up as interest on this land investment. This is one of the items which must be deducted from gross income before the amount available for construction charges can be determined.

Now it is clear that if the farmer's investment in land increases, the total interest payable annually on that investment will also increase, and because of this increased cost the repayment ability of the farmer will decline, assuming that all other factors remain stable. It is possible, therefore, to determine, through the ratio of interest on land to the amount available for construction payments, the point at which an increase in land values will completely absorb the farmer's ability to repay the Government.

Studies have shown that even a 70- and 80-percent rise in the price of land would increase interest payments on farms on the Frenchman-Cambridge Unit of the Missouri Basin project in Nebraska and on the Ogden River project in Utah to a point at which the ability of the farmers to pay for irrigation construction would be wiped out.

For example, the total interest payments at 5 percent on a 99-acre general farm on

(Continued on page 186)

Percent increase of values of unimproved land by 1913, and proportion of unpaid construction charges by 1923 on certain reclamation projects.

Project	Percent increase in value of unimproved land by 1913	Percent construction charges due and unpaid by 1923
Shoshone	5,000	23.7
Okanogan	2,900	29.0
Belle Fourche	775	36.2
North Platte	700	27.8
Yuma	291	36.3
Minidoka	1,525	10.4
Umatilla	900	12.3
Huntley	350	8.2
Sun River	75	12.3
Carlsbad	170	8.3
Newlands	108	4.5
Klamath	300	5.4

Does BEEKEEPING *Have a Part in RECLAMATION PLANNING?*

by Jas. I. Hambleton

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture

This heap of pollen (approximately 50 pounds) was gathered by a single colony of honeybees during the pollination of a variety of flowering plants. The pollen trap shown in the photo detaches the two pellets of pollen from the hind legs of the bees as they enter the hive. It is fed back to them during periods of brood rearing and inclement weather.

Department of Agriculture photos

The beekeeper examines hives for sealed honey combs. Honeybees, which are essential for the pollination of some of our indispensable fruit and seed crops also provide the only source of honey. With honeybees assuming a primary role in pollination, honey may some day be considered a by-product of the apiary.

A reclamation project involves such extensive planning and such tremendous undertakings in changing vast areas unfit for growing crops into highly productive agricultural tracts that it might seem incongruous to mention beekeeping as having any possible connection. From a monetary standpoint the production of honey and beeswax is a small part of any agricultural undertaking.

In any given area in its natural state there unquestionably exists a fairly good balance between the pollinating insects, or those that use nectar and pollen as food, and the flowering plants that produce nectar and pollen, many of which in turn require the visitation of insects for the production of seed and fruit. Any alterations in the land will doubtless affect both factors—that is, the numbers and species of plants as well as the pollinating insects that are indigenous to the area.

Most of our native pollinating insects, such as bumble bees and the solitary bees—*Megachile, Nomia, Osmia,* and others—either nest in the ground or build close to the ground in hollow stems and similar places. Almost every agricultural practice that is in vogue today has an adverse effect upon these useful insects. Plowing and cultivating the soil, irrigation practices, the use of insecticides and weed killers, burning brush, removal of wood lots, planting huge acreages to single crops—all contribute to their destruction. In fact, there is ample evidence that their numbers are steadily decreasing throughout the United States where agriculture is carried on in an intensive manner.

Although no adequate surveys have been made of the prevalence or of the number of species of indigenous pollinating insects

before and after an area has been reclaimed for agricultural purposes, the remaking of an area is sure to bring about profound changes in the insect populations. Even though insects capable of effecting pollination once inhabited the area, a complete readjustment of their means of survival and propagation to meet the new ecological surroundings becomes necessary. Granting that many crops are dependent on insect pollination, a fact not fully appreciated, are we going to leave to the slow changes of time the matter of readjustment in the new area until there are enough insects to insure adequate seed and fruit production?

The native pollinating insects, unlike the honeybees, do not store food for periods of drought or adversity. Since they do not store food, a succession of bloom is necessary for them to complete their life cycles. What happens, therefore, when 500 acres of new land are sown to alfalfa? The 500 acres at one time perhaps carried a mixed flora, which supplied pollen and nectar over a long period through successive bloom. Such flora is destroyed when the land is sown to alfalfa. Moreover, it is only on the alfalfa that is left for a seed crop that the insects have an opportunity to make their living. Although 500 acres of a crop plant which secretes nectar abundantly and furnishes ample pollen would enable the bees to live well for a short time, a single species usually does not adequately meet their food requirements. It is doubtful whether the insects in the immediate vicinity, even if their nests have not been destroyed, can muster sufficient numerical strength to trip and cross-pollinate adequately, during a 2-weeks' period, the millions of alfalfa blossoms with which they are confronted. Yet hundreds of farmers attempt to produce alfalfa seed, for example, without providing for pollination. Would it not be just as logical to rely on nature to control weeds and insect pests and to fertilize the soil?

Little is known about the life history and flying habits of most of the native pollinating insects—not enough to provide a basis for making recommendations for their conservation and propagation. Man is left, therefore, with only one species of insect that he can move into an area for pollination purposes. This insect is the honeybee, which strangely is not native to this hemisphere.

Many of our agricultural crops are completely dependent on nectar and pollen-gathering insects. Foremost of these are alfalfa and the clovers—red, alsike, white, and ladino, as well as sweet clover. Then there are important vegetables, the seed production of which requires pollinating insects. Among these can be mentioned onion, carrot, cabbage, brussel sprouts, cauliflower and other species of Brassica, and the family of cucurbits, including melons, cucumbers, pumpkins, and squash. Many of the small fruits require insect pollination. The same is true of most of our deciduous orchard fruits. Altogether about 50 crops benefit from the activities of those insects whose existence requires season-long availability of nectar and pollen.

It would be folly to sow a crop without preparing the seedbed and without making certain that the right growth elements exist in the soil and that proper moisture conditions prevail. Measures must be taken to control injurious insects and plant diseases; yet pollination, which is essential for so many crops, has been generally left to chance. Today we readily see the results of this neglect. Through a period of many years there has been a steady decline in the per-acre seed production of our principal legumes. Unquestionably one of the reasons why many seed and fruit growers are not producing maximum crops is the lack of sufficient insects to bring about flower fertilization.

In an area newly developed for agricultural purposes the need to supply pollinating insects must be even greater than in one that has been long established, where commercial beekeeping has gotten a foothold, and thus made available millions of pollinating insects to supplement the rapidly disappearing native insects.

Although from a monetary standpoint beekeeping does not rank high among agricultural pursuits, there is little doubt that the services of bees to agriculture in seed and fruit production are worth many times the value of the crop of honey and beeswax. Beekeeping can thus be thought of as an agricultural catalyst, without which maximum seed and fruit production is not possible. Should beekeeping not have a place in reclamation planning, even if it has to be fostered on an artificial basis for a few years until the honeybees can pay for their keep in honey and pending the possible establishment of native pollinators in numbers to insure good crops?

NEXT MONTH—Officials of the Bureau of Reclamation answer Mr. Hambleton's question, with actual facts and figures regarding beekeeping in the reclamation area.

Holing Through in 1909

(Continued from page 174)

hard-bitten muleskinners drove six-horse teams down the mountain over a road that dropped 2,000 feet in 4 miles with horses and wagons practically skidding down grades as steep as 25 percent. Drivers had to manipulate the lines and wagon brakes with considerable agility to avoid mishaps.

The tunnel was holed through in 1909 although it was not until approximately a year later that enlargement work and the lining of some sections was completed. Since delivery of water was begun, the tunnel has served the farmers of the Valley regularly and faithfully without a major shut-down during an irrigation season.

Problems of a Project Manager

(Continued from page 175)

of filmy moss that are forked out in spongy piles near headgates and bridges. The evaporation from surface water in the hot sun cuts down the amount that finally reaches the thirsty fields. Demands for water and more water increase as the crops grow heavy and stretch up toward the harvest.

The project manager relies at this time more than ever on the office crew to carry on while he drives the canal banks, chats with farmers briefly, and keeps his eyes on the general trend of water conditions and the crops. Foremen and ditchriders, repair crew, and extras are using all of their skill and ability and experience to get the water to the farmers, for this is the peak of the water season. Not the least of the project manager's attributes is the tact that he is sometimes required to use in handling farmers and farmers' wives, who, in spite of everything, feel that they are not getting their just proportion of water.

There is a legend in the Boise Valley of a woman farmer with a rugged disposition who contended mightily with her neighbor over a stream of water. The neighbor contended just as mightily in return. Regularly as the water was turned down the lateral and the headgate was raised, the lady arrived with a shovel in her hand and slammed down the headgate. Hot conferences, punctuated with loud arguments, wild threats, and dire maledictions accomplished little. The ditchrider, always anxious to avoid trouble, was called in and used all the reasoning he could muster.

Finally an injunction was issued against her, and when the papers were served she promptly sat down in the lateral, being of a build that would obstruct the law as well as the free flow of water. Only the finesse and adroit strategy of the manager who arrived shortly and saw the humor in the situation persuaded the lady to arise and conciliate. Many such issues are met and peacefully settled. Some have in them the elements which might lead to actual bloodshed.

As the season advances, the crops mature and the need for water lessens. Though the haystacks that dot the still green fields of September are not the actual possession of the man who runs the canal, yet he feels that he has had a part in their abundance. Though the vast potato acreages are not his own, his pride is unbounded as the smooth tubers roll down the belt of the digger and the sacks bulge with their fatness.

By the time the last truck of sugar beets roars up to the railroad siding and is unloaded, the manager is out on a final inspection tour of the system with his foreman, looking for evidence of the summer's wear and tear on the canal and lateral, planning again the work of the coming spring.

For the project manager, his life is wrapped up in water, and for the farmer, water means growth and life.

Tucumcari's Champions

The inside story of the many obstacles met and surmounted by progressive pioneers in their long fight for an irrigation project at Tucumcari, N. Mex.

by John P. Woodward
Chief of the Project Activities Section, Region V, Amarillo, Tex.

Photo by D. B. Parker, Region V

Henry R. Priddy, Tucumcari businessman, farmer and civic leader, president of the Arch Hurley conservancy district.

Photo by Dale Hovey, Region V

Arch Hurley whose efforts helped make Tucumcari's long-sought irrigation development possible.

Photo by D. B. Parker, Region V

Royal A. Prentice, who worked for 40 years to convert 45,000 acres into productive cropland.

In northeastern New Mexico, where the rolling foothills of the Rocky Mountains diffuse into flat prairie, 45,000 acres of dusty grazing land are being converted into cultivated fields by the time-tested practices of irrigation. The irrigated acreage is being developed by the Bureau of Reclamation near the fast-growing city of Tucumcari, whose population, approximately 10,000, has doubled in the past six years.

Tucumcari derives its name from an ancient Indian legend involving two lovers, Tocom and Kari. In conflict with a tribesman over the affection of Kari, Tocom was slain. Heartbroken over the loss of her lover, Kari leaped to her death from an escarpment in the vicinity, now known as Tucumcari Mountain.

Tocom and Kari were members of the semi-civilized Pueblo tribes who settled in the upper reaches of the Canadian River. Pueblo ruins in the vicinity show evidence of Indian culture dating back to a period from 1000 to 1200 A. D.

The home-building, farming Pueblos were driven back toward the Rio Grande by marauding bands of nomad Indians, then living on the plains to the east, who stole the Pueblo women and children and destroyed the crops stored by the farmers. In turn, the Plains Indians were driven out by the early Spanish settlers who repaired and extended the irrigation systems built by the Pueblos. All of these developments along the Canadian and its tributaries were destroyed by floods, but faint traces remain of the many miles of irrigation ditches which were built by the Spaniards and the Indians.

It was a long time before the Anglo-Americans displayed as much faith in the country as their predecessors had shown.

People began trickling into the area as early as 1832. After the Civil War came the days of the huge land grabs in the Southwest and the cattlemen moved in. The idea of farming this semi-arid region was buried under an obsession for obtaining more and more land on which to graze herds of cattle which were rapidly increasing in size during the late nineteenth and early twentieth centuries.

At the turn of the century homesteaders had tried farming in the Tucumcari area but by 1910 most of these, failing to make a success of dry-land farming, had disposed of their interests to the livestock men. But a small group near Logan on Ute creek, a tributary of the Canadian, clung to their holdings. They realized that this would be a wonderful country if water were available when needed. The idea of irrigation was germinating.

The man who was chiefly responsible for the revival of irrigation interest in the Tucumcari area after several hundred years of dormancy is Royal A. Prentice. An alert, bird-like man, whose sharp eyes and brisk movements belie his 72 years, Prentice practices law from his Tucumcari residence when he is not otherwise occupied, usually with some Boy Scout enterprise or civic development program.

Prentice was born in New York State at the time that Horace Greeley was at the height of his popularity. His parents may have been influenced by the teachings of the great journalist and statesman to "go west." At any rate, in 1879 Prentice was in Las Vegas, N. Mex.

The Spanish-American War found an eager volunteer in Royal Prentice, who was mustered into service at Santa Fe and joined Teddy Roosevelt's Rough Riders. He is one of three known veterans of that famous unit still living in New Mexico. From 1904 to 1908 he was employed by the Old El Paso-Northeastern Railway Co., leaving in 1908 to go to Tucumcari as Register of the United States Land Office.

It was in this capacity that Prentice first became interested in the possibilities of irrigation. In the Land Office he had access to records of the Red River Company and noted that a dam had been built on the Bell Ranch. Inquiry proved discouraging, as the Bell manager stated that the dam had been washed out a few days after it was built. However, settlers on Pajarito Creek and Ute Creek, both Canadian tributaries, were interested and in 1910 had formed the Interstate Land and Development Company and employed John H. Marks, a civil engineer, to make preliminary surveys.

Ralph J. Freeland, a Ute Creek resident, was particularly interested and in 1911,

Photo by Ray Reynolds, Region V

Directors of the Arch Hurley conservancy district, Murel Starr, U. S. Devor, G. A. Eager, Arch Hurley, Earl George, Ben Munoz, H. R. Priddy, Mrs. Irene Kearns, and James L. Briscoe.

W. B. Freeman, another civil engineer, was brought in to make a survey on both Ute Creek and Pajarito Creek. Freeman's extensive report covered a plan to irrigate 30,000 acres in the vicinity of Tucumcari. The project looked good, but there was the big problem of obtaining funds.

An important event in the development of the Tucumcari irrigation project occurred in 1918 when Gen. George W. Goethals, who had gained fame in construction of the Panama Canal, came to Santa Fe. Al Renehan, a Santa Fe attorney, knew General Goethals and interested him in the Canadian river development. Prentice was notified, went to Santa Fe and returned with General Goethals. After inspection of a stretch of the river, Goethals offered an opinion that a site on the Canadian just below its confluence with the Conchas river appeared best suited for a dam. He selected almost the exact location of the present Conchas dam, which created the Conchas Reservoir, source of water supply for the Tucumcari project.

John Morrow of Raton was New Mexico's representative in the National Congress in 1920 and his constituents in the upper Canadian Valley solicited his support for the project. A party including Prentice, Sisney and M. B. Goldenberg took Morrow on an inspection tour of the Canadian and when Morrow returned to Washington he immediately went to work to interest the Army Engineers in an investigation. This same year, 1920 brought support from interests in other States following serious floods on the Canadian and Arkansas rivers. The 1924 Flood Control bill included surveys for the Cimarron and Canadian rivers. On May 23, 1924, after the bill had been passed by the Senate, Morrow wrote: "The first step is completed. It is now up to us to cooperate with Oklahoma for flood control."

Ralph J. Freeland, who had worked for the development of irrigation along Ute Creek shortly after the turn of the century, had maintained a keen interest, and in the early 1920's became the leader of the plan for a project near Tucumcari. In 1923 the New Mexico Land and Development Company was formed with R. A. Prentice as the first statutory agent. One of the most important developments under Freeland's supervision was organization of the Canadian Valley Development Association in 1925.

The Association was formed to foster flood control and irrigation through storage of waters of the Canadian and its tributaries. An interstate compact was sought between New Mexico, Oklahoma, Texas and Arkansas. In the meantime, E. E. Blake of Oklahoma City was instrumental in the organization of an Arkansas River Control Commission.

Two other Tucumcari men, who had long been identified with progressive development of the area, actively entered the fight for an irrigation project in the 1920's. Freeland's right-hand-man was James L. Briscoe, an attorney and pioneer settler of the territory who unselfishly devoted much of his time, the greater portion without pay, to activities of the Canadian Valley Development Association.

The other notable addition to the fight was H. B. Jones, a banker who came to New Mexico from Michigan in 1910. He lent financial stability to the movement and played an important part in the increasingly frequent drives for funds to carry on the work.

Freeland, Jones and Briscoe in 1925 were appointed by the Governor of New Mexico as permanent Commissioners for the Canadian River Project in New Mexico. In this capacity they made frequent trips to points in New Mexico and neighboring states. Irrigation became secondary to flood control as support for the latter phase grew in Kansas, Arkansas, Oklahoma, Texas, and Louisiana. At an interstate meeting at Little Rock, Ark., in January 1926, it was stated that the practical place to control floods was in the Mountain States near the source, and the lower States would support such a plan. Freeland, Jones and Briscoe returned from the interstate meeting and immediately started work on the formation of a Tri-State compact.

Freeland died in the saddle. Beginning in 1922, he had devoted most of his time and a considerable amount of money to promoting the development of the upper Canadian basin. He became ill in Santa Fe while working for his project and died in March 1927, not knowing that the Tri-State pact for which he was plugging had been approved by the legislature.

Following the death of Freeland, Judge Briscoe and banker Jones continued the crusade. But a man was needed to carry the battle to the Federal Government.

Arch Hurley was selected for the job. The choice proved an excellent one. Hurley cleared almost unsurmountable obstacles in the succeeding years and carried on the fight when many a less courageous standard bearer would have surrendered.

Briscoe had asked that Hurley be included along with Jones in a delegation to attend a National Drainage Congress at Amarillo in April 1927. Hurley proved an able representative and was appointed by Governor Dillon of New Mexico as the State's representative to the Flood Control Conference held in Chicago during June 1927. At the conference he was elected to the executive committee.

Hurley's position was strengthened through appointment to two organizations resulting from the Flood Control meeting—the important Mississippi Flood Control Association and the Arkansas Basin Committee. The former represented 31 Mississippi Basin States, and the latter the 7 Arkansas Basin States (Arkansas, New Mexico, Colorado, Kansas, Texas, Oklahoma, and Missouri).

Passage of the Flood Control Bill of 1928 was threatened with a veto but Hurley was able to convince President Coolidge that $325,000,000 was necessary for the work and the bill was signed.

An investigation and survey of the Arkansas River and its tributaries was included in the River and Harbor Act of January 21, 1927, and the Mississippi River Flood Control Act approved May 15, 1928. Certain studies to be made on the Canadian were included.

A preliminary examination of the Canadian River and its tributaries in New Mexico was authorized by an act approved February 12, 1929. This was carried out by the Corps of Engineers, War Department, which on April 24, 1930, reported unfavorably on a flood control project, stating that "no further survey of the Canadian, with a view to the control of its floods, is advisable at this time."

This temporary setback served only to stimulate Hurley to greater efforts. One of the reasons for dropping the project given

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Shoshone's "Irrigation Institute"

Veterans of World War II, settling on the Heart Mountain reclamation project, don't have to go to school to learn to make a success of irrigation farming. Under the G. I. Bill of Rights, the school comes to them.

by John K. Black

Settlement Specialist, Shoshone Reclamation Project, Powell, Wyoming, Region VI

Photo by C. I. Conaway, Region VI

John K. Black, settlement specialist (left) and Lloyd J. Klingle, engineer in charge of predevelopment on Shoshone, show Forest J. Neville lay-out of land openings.

"If I had only known!" is the plaintive cry of many a reclamation farmer as he looks back upon his first years of living "under the ditch."

Experience is still the best teacher, but when a man and his family are alone with a new type of farm, far from neighbors or counselors, this best of teachers often turns out to be mighty expensive.

After more than forty years of reclamation experience, plus the great strides recently taken in the art of agriculture, it appears about time to discard the old trial and error methods and take advantage of the accumulated experiences of irrigation farmers.

On the Heart Mountain Division of the Shoshone Reclamation project in northwestern Wyoming, settlement specialists are seeking to do that very thing, with the help of the "G. I. bill of rights." Reclamation personnel who are assisting settlers in getting started on their new farms have made it a part of their job to consider all phases of the G. I. bill to determine where it could be put to use in furthering successful settlement of the project.

They found that one feature of the G. I. bill provides for veterans' training in agriculture. A veteran may either sign up for training with an experienced farm operator as his instructor for on-the-farm training, or he may take advantage of institutional training through a public school system. In the latter case, the veteran selects the phase of agriculture which he wants to study, and a suitable course is designed and supervised by the vocational agricultural section of the school.

At Heart Mountain, veteran settlers are situated about twelve miles from the nearest vocational agricultural department. As they can't take time out from their rigorous first year of irrigation farming to travel the distance from homestead to class room and shop, the school is being brought to them.

So far, the program is in the planning stage. In making the plans, all existing training facilities in the area have been rounded up. Various agricultural agencies in Park County, the Wyoming State Department of Education, and the Veterans' Administration are working together to make a success of the program which will help the soldier-turned-farmer to make a success of his farm.

A United States Department of Agriculture Council was already functioning in Park County when the program was first discussed, and it was determined that this council should act as the agricultural training committee. The council was given responsibility for initiating the program and advising the State Department of Education, and the Veterans' Administration of the plan's progress. The USDA council, in addition to the agencies of the Department of Agriculture, includes other agencies working on agriculture, such as the Bureau of Reclamation and local vocational agricultural instructors.

The Wyoming State Department of Education has been given the responsibility for hiring instructors and approving the course of training for each veteran. At the present time qualified instructors are difficult to obtain. Representatives of the State Department of Education have been keenly interested, however, in getting the program under way and are determined to find instructors who can teach farm management right out on the farms in a way that will most definitely benefit the veterans.

The Veterans' Administration must certify each veteran for training and satisfy itself that the veteran is eligible for subsistence payments of $65 per month to single veterans and $90 per month to those with dependents. Representatives of the Veterans' Administration have been extremely desirous to get their end of the job under way and have expressed the belief that this type of training is definitely in keeping with the spirit and interest of the G. I. bill. In order to qualify for training the veteran must make application at the nearest Veterans' Administration Office. He must present a copy of his service discharge so that the period of training for which he is eligible can be determined. After he is certified as being eligible for training, the State Department of Education is notified and it then becomes its responsibility to provide instruction. This will be accomplished either through vocational agricultural departments of nearby high schools or by hiring full-time instructors. The latter method is planned for Heart Mountain, and instructors will spend their full time with the group assigned to them. To date 28 veterans on the Heart Mountain Division have made application to the Veterans' Administration for training. These applications are being processed as rapidly as possible. It is planned that two groups of from 12 to 20 veterans will be organized soon; each group to have a full-time instructor.

The school districts or other sponsoring agencies are to be reimbursed by the Veterans' Administration which finances the

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Land Speculation

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the Frenchman-Cambridge unit, worth at present $93 an acre, would amount to $461.50 a year. Analysis shows that on a farm of this type there would be available a maximum of $359 a year for repayment of construction charges. An increase of land values to $167 per acre, or 77.7 percent, on this farm would destroy all of its estimated repayment ability.

The value of the Reclamation law to landowners in terms of benefits from interest-free money and subsidies from power and municipal water revenues is not thoroughly understood even by those who live right on the Reclamation farms. All too frequently it is forgotten that the costs of the irrigation works, if they had to be privately financed at even 2½ percent for a period of 40 or 50 years, would be almost twice as great as they are under Federal Reclamation law. Again, on many projects the landowners are required to repay only a fraction of the construction costs allocated to irrigation. This may be in some instances as low as a fourth of these costs—the balance, or three-fourths, being repayed to the Federal Government by reason of power and municipal water revenues received from the operation of the project. These savings to landowners, which under private development they would have to pay, result in water costs of only a fraction of what they would be under private development. Lower costs mean greater net returns to farmers. Greater returns from the land mean greater land values. It is these increased land values derived from Federal aid which the antispeculation features of the law have kept the speculators from grabbing.

To jog the memory of those who may have forgotten, after a score of years of operation under the present satisfactory law, here is a statement by Senator Carl Hayden of Arizona (then a member of the House) during the hearings of the Committee on Irrigation and Reclamation on the Fact Finding Bill (H. R. 8836 and H. R. 9611) during May 1924. At that time the United States had had 22 years of reclamation experience.

> It has been the history of every project up to this date (1924) that somebody realizes when a land boom is coming and buys land as cheaply as it can be obtained. He does not intend to cultivate it and does not cultivate it, but waits until about the time the water is supplied, and then he can paint a beautiful picture, the water is going to be provided, and the desert is going to blossom and bloom like a rose, and he sells it. And who comes on? The actual farmer to whom the United States must look for a return, and we have had around this table year after year the water users complaining that they could not meet their charges and that the Government was a harsh creditor. They never realized it, but when we came to analyze their private finances we invariably found that they owed $4 to somebody else for every dollar they owed to the United States.
>
> You ask one of those men, "What is your financial situation," and he will tell you, "I came into the project when it was about to be opened, and I paid $200 an acre for irrigable land, and that was about the price for land at that time, and I paid $50 down and have a mortgage for $150 more at 8 percent."
>
> His construction charge may be $50 or $60 an acre on which he has no interest to pay, and the principal spread out over 20 years, and it does not amount to but about one-fifth of his debt or his immediate obligations, yet he is asking to be relieved from that while he cannot get any relief from the man to whom he gave the mortgage and to whom he paid this fancy price for the land.

Year after year the settlers, who were the people for whom the projects had been built and who were the victims of the speculators, besieged the Congress seeking relief from their construction charges. Representatives and Senators have been spared that since 1926.

In summarizing, our experience with land speculation on the early projects shows that it produced land-boom prices 759 percent above actual values; it led to widespread delinquency in payment of construction charges on project after project, and it bankrupted settlers, but fattened speculators. The antispeculation provisions incorporated in the law of 1926 have effectively curbed speculation on projects begun since then.

Australia's Rural Reconstruction Commission in its Eighth Report (1945) on *Irrigation, Water Conservation and Land Drainage* to the Minister for Post-War Reconstruction stated:

> The Commission makes the following recommendations. . . .
>
> (*a*) That attention be paid to determining the most equitable allocation of the capital costs of any irrigation work between the State and the water-users.
>
> (*b*) That without penalizing existing landowners, steps be taken to prevent them from making capital profits out of a rise in land values consequent on irrigation proposals and plans.

Shoshone's Irrigation Institute

(Continued from page 185)

entire program, for expenditures incurred because of the Veterans' Training Program.

Instruction will consist of three parts:

(1) The instructor will visit the trainee on his farm at regular intervals for a minimum of 100 hours per year for the purpose of providing instruction in management and operation of the farm.

(2) The trainee will receive 200 hours per year of organized off-farm related instruction in the class room, shop or laboratory. This instruction will be given by the instructor who visits the veteran on his farm.

(3) Instruction in the form of trainee improvement assignments will be made which will include all phases in the operation of the farm.

At Heart Mountain it is planned that emphasis will be placed on planning the irrigation system and laying it out on the farm. In the shop, irrigation structures can be fabricated using lumber salvaged from buildings formerly used by Japanese evacuees who lived at the War Relocation Authority camp located on the project during the war. Many of the settlers have never operated irrigated farms before and will require individual assistance. It is felt that on-the-job visits by the instructor will be invaluable to the new settler in making the adjustments necessary on the irrigated farm.

One purpose accomplished by planning for the Veterans' Training Program is the fact that it has brought together all agencies concerned with agriculture on a common program. It has assisted in the establishment of a cooperative relationship between Bureau of Reclamation officials, USDA agencies, the Veterans' Administration, and the State Department of Education.

This one-purpose program—the joint efforts of settlers, Government agencies and local institutions—offers the opportunity of materially improving the prospects of the veteran homesteaders in developing successful farm homes.

Tucumcari's Champions

(Continued from page 184)

by the Corps in its adverse report was the small amount of damage resulting from floods. Hurley and a group of interested persons toured the entire length of the Canadian gathering data on flood damage. Hurley continued his frequent trips to Washington where he received invaluable assistance from the New Mexico Congressional delegation. Senators Carl A. Hatch and Dennis Chavez and Representative John J. Dempsey worked faithfully in behalf of the project.

In 1934 an Arkansas Basin Committee was created by Secretary of the Interior Harold L. Ickes to make a complete investigation of the watersheds of the Arkansas River. Hurley was appointed a member of this committee by the late President Franklin D. Roosevelt. This proved an opportunity to keep the Conchas Dam proposal in the picture, and gain valuable support for the project.

The construction of the dam by the Corps of Engineers was approved by President Roosevelt on July 29, 1935, under the Emergency Relief Appropriation Act. It was adopted by Congress in the Flood Control Act of June 22, 1936, to provide flood control, irrigation and municipal water supply benefits. An Engineer District of the War Department was established at Tucumcari August 1, 1935. Excavation operations were begun December 20, 1935. Construction was completed in 1939.

Meanwhile, Hurley was at work on the Tucumcari irrigation project. A reconnaissance survey was made by the Bureau of Reclamation in March 1936. Authorization for a detailed investigation was made in July 1936 and surveys were started in October of that year.

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NEWS ROUND-UP

Veterans' Preference Revised

When the President signed H. R. 603 on May 31, 1947, the Veterans' Preference Act of 1944 was amended to grant preference to honorably discharged veterans who were in the military or naval forces of the United States for a period of at least ninety days at any time on or after September 16, 1940, and prior to the termination of the present war for homestead entry on public lands. Previously only those who were in the armed services on or after December 8, 1941, for a period of at least 90 days held this privilege. It also permits a spouse, either husband or wife, to take over the veteran preference benefits in case of death of the qualified veteran. In the event of marriage of the surviving spouse, the preference is carried over to the surviving children of the deceased qualified veteran.

Commissioner Authorized To Award Top Value Contracts

When Commissioner Straus recently awarded the $5,888,000 contract for construction of the 2½-mile Delta-Mendota Intake Canal, including the Tracy Pumping Plant and discharge lines for the Central Valley project in California, it marked the first contract award by a Reclamation Commissioner in excess of $500,000 in the Bureau's history.

Under Secretary Krug's new delegation of authority the Commissioner is authorized to award contracts without limitations as to the amount involved for construction equipment and supplies, and services. Heretofore the amount of a contract that could be awarded by the Commissioner without specific delegation of authority by the Secretary of the Interior was limited to $500,000.

The Delta-Mendota Canal is one of a system of canals in the Central Valley project which constitutes the major irrigation feature of the project. The system will provide irrigation for new lands as well as supplement the water supply to inadequately watered lands which combined are in excess of 2,000,000 acres. The pumping plant near Tracy, also covered in the contract, will lift water from the Delta-Mendota Intake Canal to a height of 200 feet and send it flowing for a distance of 120 miles, through the Delta-Mendota Canal, along the west side of the San Joanquin Valley. Six large electrically-operated pumps for the plant are now being fabricated under a contract awarded last year.

Frenchman-Cambridge Repayment Contract Signed

Clyde Payne (left) President of the Frenchman-Cambridge Irrigation District, is shown signing the new repayment contract between his district and the United States during the recent Enders Dam Celebration. Shown with Payne are Secretary of the Interior J. A. Krug, and Don Thompson, Secretary-Treasurer of the Frenchman-Cambridge District. See NEW REPAYMENT PROPOSALS FOR THE MISSOURI RIVER BASIN, February 1947 ERA for contract details.

Climatic Trends in Irrigated Areas

Sumner P. Wing of the Branch of Design and Construction has tentatively concluded that irrigated areas have been getting hotter and drier the past 50 years as a result of a study he has been conducting on climate fluctuations.

He has collected long-time weather records on various parts of the world, including a graph of run-off variations of the Nile River during the past 13 centuries from engineers representing foreign governments who have visited the Bureau of Reclamation. While the apparent decrease in rainfall is not well established by hydrologists, Mr. Wing's study cites an abundance of evidence to support the increasing temperature.

San Diego Aqueduct Nearing Completion

Construction of the San Diego Aqueduct is expected to be completed in October according to the present schedule. This project was initiated in 1944 under the direction of Assistant Secretary of the Interior, William E. Warne, then Assistant Commissioner of Reclamation, who was appointed Chairman of the Committee to study the problem, by the late President Franklin D. Roosevelt.

The aqueduct is designed to relieve a critical municipal water shortage in the San Diego area. Bureau personnel played a large part in assisting in the investigations, and in preparing the plans, specifications, and estimates for the project which is being constructed by the Navy Department.

As Australia Sees It

In the recent edition of Australia's Handbook on Testing Soils, the Bureau of Reclamation is featured on the opening page, as follows: "The procedures used, with the exception of the direct tear sheet test, are based on those adopted by the American Society for Testing Materials, Harvard University, and the United States Bureau of Reclamation."

Attention Visitors From Abroad

If you are planning to include a visit to a Reclamation Project in your itinerary during your stay in the United States, we suggest that you first go to the American Embassy, Legation, or Consulate in your country and discuss your plans. By doing this, a direct clearance may be expedited for you, thus saving you considerable time during your travels.

ITA Suspends Operation

At a recent meeting of the Board of Directors of the International Training Administration, Inc., it was voted to suspend operatitons of the institution.

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

2. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939. 7-page mimeographed study with graphs.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *High-Pressure Reservoir Outlets,* by J. M. Gaylord and J. L. Savage—a report (1923) on Bureau installations compiled from correspondence, project histories, feature reports, technical papers, special reports prepared for this purpose, and from personal inspection of the installations described. Obtainable from the Superintendent of Documents.

2. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

3. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest release is: Standards and Levels of Living, studies by the Department of Agriculture for Problem 9—20 cents.

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 24, Agricultural Processing Industries—30 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

4. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

5. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

Engineering Publications

Available on Loan from the Design and Construction Technical Library, Bureau of Reclamation, Customhouse, Denver, Colo.

Building Code Requirements for New Dwelling Construction, Report No. BMS-107, by U. S. Department of Commerce. For sale by Superintendent of Documents, $0.20.

In this publication the National Housing Agency, with the cooperation of the National Bureau of Standards, has recorded its views on what constitutes reasonable building code requirements for dwellings. These requirements have as their base a number of standards that have been developed by representative committees. Where specialized experience in the housing field has made it seem advisable to make additions, modifications, or exceptions to these basic standards, this has been done. The aim has been to provide sound construction without excessive cost and with adequate provision for recognizing new developments in the building field as they occur. Farmers should find this code useful in determining minimum insurance requirements for building. It contains good standards for plumbing.

Recent translations by the Technical Library:

A Contribution to the Chemical Investigation and Treatment of Clay Soils, by K. Endell, from "Bautechnik," 1935, Vol. 13, No. 18.

Electro-Chemical Method of Increasing Bearing Power of Pile Foundations in Clayey Soils, by L. Erlenbach, from "Bautechnik," 1936, Vol. 14, No. 19.

Soils Consolidation by the Electro-Chemical Method, by Leo Casagrande, from "Bautechnik," 1939, Vol. 17, No. 16.

Large Scale Test to Increase the Carrying Capacity of Floating Pile Foundations by Electro-Chemical Treatment, by Leo Casagrande, from "Bautechnik," 1937, Vol. 15, No. 1.

Miscellaneous Publications

Agriculture and Peace, by Clinton P. Anderson, Secretary of Agriculture, in *The Western Farm Life (1947) Annual Livestock Review*, page 10. Illustrated. Secretary Anderson concludes, "We recognize the interdependence of the agriculture of the West with the agriculture of all other regions of this country, and we are beginning to realize the interdependence of our own agriculture with that of the whole world." For information write to *The Western Farm Life*, Denver, Colo.

Tucumcari's Champions

(Continued from page 186)

The Secretary of the Interior was authorized to construct a Federal Reclamation project for the irrigation of lands in the Arch Hurley Conservancy District by the act of August 2, 1937 (50 Stat. 557). This act was later amended by the act of April 9, 1938 (52 Stat. 211).

The big hurdle had been made, but events proved there was a lot of work yet to be done. There was no provision under the laws of the State of New Mexico whereby a conservancy district could enter into a contract with the Government. Hurley went to Washington and got help in preparing a bill authorizing contractual relationship between the conservancy district and the United States. Hurley returned with the bill and submitted it to the Fourteenth New Mexico Legislature, which passed it in the early spring of 1939.

The first Conservancy District Board was comprised of H. B. Jones, J. W. Bullington, Arch Hurley, G. A. Eager, and U. S. Devor. David S. Bonem was named secretary. Hurley, Eager and Devor are still members. H. R. Priddy is now president. Ben Munoz, secretary-treasurer, and Earl George is a director. James L. Briscoe is the attorney for the district.

Bids for the construction of the first 20 miles of canal were opened November 16, 1939. Satisfactory bids were obtained on all schedules and contracts awarded. It appeared as though the dreams of early settlers were becoming a reality, but delays were still ahead. In December 1942, work was suspended by order of the War Production Board on many western reclamation projects including Tucumcari.

Through the efforts of Hurley and Senator Hatch it was reopened as a war foods project.

Construction was resumed after a delay of 18 months and, late in 1945, water was first delivered to the project. In 1946 crops were irrigated on 2,526 acres. By the close of 1947 the Bureau is scheduled to have facilities completed for the irrigation of approximately 22,000 acres, with about 6,000 acres actually receiving water for 1947 crops.

It was a hard fight won by the tenacious efforts of men with faith and vision, many of whom did not live to see the realization of their dreams. It would be impossible to name all who contributed in one way or another. In addition to those already mentioned there were O. S. Greaser, H. K. Grubbs, L. D. Stith, Lee G. Person, Leon Sands, the McFarland brothers, C. B. Hamilton, E. J. Corn, O. B. Erskine, and perhaps a score of others. Names like Prentice, Freeland, Jones, Briscoe, Hurley, and these others should be long remembered by those who will reap the benefits of the Tucumcari Irrigation project.

NOTES FOR CONTRACTORS

Contracts Awarded During June 1947

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1729	Shoshone-Heart Mountain, Wyo.	June 2	Electrical equipment for Heart Mountain switchyard and Garland substation, schedules 2, 3, 4.	General Elec. Co., Denver, Colo	$38,281.84
1745	Colorado-Big Thompson, Colorado.	June 11	3 vertical-shaft 6,600 volt synchronous motors for Granby pumping plant.	do	376,240.00
1754	Davis Dam, Ariz.-Nev	June 13	5 45,000/56,250/60,000 kva transformers for Davis power plant.	do	1,081,300.00
1762	do	June 30	Electrical equipment for Phoenix and Tucson substations, schedules 2, 3, 9.	do	274,308.00
1768	Rio Grande, N. Mex.-Tex.	June 20	Electrical equipment for Socorro substation, schedule 1.	Westinghouse Elec. Corporation, Denver, Colo	47,439.00
1769	Missouri Basin-Kortes, Wyo.	June 30	Electrical equipment for Kortes switchyard, schedule 1.	Pacific Elec. Mfg. Corporation, San Francisco, Calif.	105,710.00
1769	do	June 17	Electrical equipment for Kortes switchyard, schedule 2.	Southern States Equipment Corporation, Hampton, Ga.	32,946.32
1772	Missouri Basin-Frenchman-Cambridge, Nebr.	June 5	1 84-inch diameter welded-plate-steel outlet pipe for Enders Dam.	Thompson Pipe & Steel Co., Denver, Colo	26,073 00
1774	Columbia Basin, Wash	June 16	Electrical equipment for units L1, L2, L3, L5, L6 Grand Coulee power plant, schedule 1.	General Elec. Co., Denver, Colo	22,500.00
1777	Gila-Yuma Mesa, Ariz	June 11	6 pumping units for relift pumping plants at A and B Canals and laterals.	Crane-O'Fallon Co., Denver, Colo	14,878.00
1779	Davis Dam, Ariz.-Nev	June 4	10 turbine draft-tube pier noses for Davis power plant.	Columbia Steel Co., San Francisco, Calif	34,530.00
1780	Columbia Basin, Wash	June 11	Preparation concrete aggregates at Potholes deposit, schedule 1.	J. G. Shotwell, St. John, Wash	83,450.00
1781	Central Valley, Calif	June 2	Steel partitions for Shasta power plant	George T. Gerhardt Co., San Francisco, Calif	18,087.00
1787	Columbia Basin, Wash	June 30	Construction 13.8 kilovolt transmission line	Agutter Elec. Co., Seattle, Wash	74,322 80
1810	Central Valley, Calif	June 23	Construction Delta-Mendota Intake Canal and Tracy pumping plant and discharge lines.	Stolte, Inc., United Concrete Pipe Corp., Ralph A. Bell, Duncanson-Harrelson Co., Oakland, Calif.	5,888,695.00
1813	Provo River, Utah	June 30	Construction pipe line, tunnels, and structures, Salt Lake Aqueduct, schedule 2.	United Concrete Pipe Corp., Baldwin Park, Calif.	1,620,884.00
1816	Colorado-Big Thompson, Colo.	June 30	Excavation and concrete lining for tunnels 2, 3, 4, 5, Horsetooth Feeder Canal	Tunnel Constructors, Denver, Colo	1,838,352.75
1817	Central Valley, Calif	June 30	Preparation concrete aggregates at Friant deposit, Friant-Kern Canal.	George Pollock Co., Sacramento, Calif	191,550.00
1824	do	June 30	Six 22,500 hp vertical-shaft synchronous motors for Delta-Mendota pumping plant.	Allis-Chalmers Mfg. Co., Denver, Colo	1,710,000.00
1825	Colorado-Big Thompson, Colo.	June 30	Construction Olympus Dam	David G. Gordon and Bressi and Bevanda Constructors, Inc., Denver, Colo.	1,375,479.00
1830	Central Valley, Calif	June 30	Two-50,000 kva condensers and starting autotransformers for Delta substation.	General Elec. Co., Denver, Colo	692,800.00
1835	Columbia Basin, Wash	June 30	Electrical equipment, Grand Coulee power plant	General Elec. Co., Denver, Colo	17,717.00
1836	Minidoka, Idaho	June 27	Electrical equipment for Burley and Rupert substations, schedules 1, 2.	General Elec. Co., Denver, Colo	55,110.33
1836	do	June 27	Electrical equipment for Burley and Rupert substations, schedule 3.	Allis-Chalmers Mfg. Co., Denver, Colo	62,210.00

Construction and Supplies for Which Bids Will be Requested During August 1947

Estimated date bids to be invited	Project	Description of work or material
Aug. 1	Boulder Canyon, Nev	Supplemental water supply pipe line for Boulder City.
Aug. 1	Central Valley, Calif	Construction of Delta-Contra Costa-Clayton and Ygnacio 69 kilovolt transmission lines, including 39 miles of single wood pole, and 9 miles of 2.3 kilovolt underbuild.
Aug. 1	Davis Dam, Ariz.-Nev	Construction of 83 miles of 230 kilovolt transmission lines from Davis Dam to Parker Dam. Steel structures and towers.
Aug. 1	do	Construction of 25 miles of miscellaneous transmission lines, 34.5 kilovolt, wood poles, Yuma-Arizona area.
Aug. 1	do	Draft tube bulkhead gates for Davis Dam.
Aug. 1	do	23-ton gantry crane for Davis Dam.
Aug. 1	do	Motor driven air compressors, after cooler and air receivers for Davis power plant.
Aug. 1	Missouri Basin-Frenchman-Cambridge, Nebr	60-inch hollow jet valve for Enders Dam.
Aug. 1	Missouri Basin-Kortes, Wyo	Water supply piping and gallery drain piping for Kortes Dam.
Aug. 1	Provo River, Utah	Siphons and pump discharge lines for Jordan Narrows pumping plant.
Aug. 1	do	18-inch and 30-inch butterfly valves for Jordan Narrows siphons.
Aug. 1	Shoshone, Wyo	Construction of 4 miles of laterals and 25 miles of sublaterals for irrigation of 10,000 acres.
Aug. 3	Missouri Basin-Boysen, Wyo	Turbines and governors for Boysen power plant.
Aug. 5	Davis Dam, Nev.-Ariz	Construction of five 22 ft. diameter welded, plate steel penstocks for Davis Dam and power plant.
Aug. 10	Columbia Basin, Wash	Motor driven air compressors, after cooler and air receivers for Grand Coulee power plant.
Aug. 11	Missouri Basin-Frenchman-Cambridge, Nebr	Construction of earthwork and structures for 12.5 miles of Cambridge Canal.
Aug. 15	Boise, Idaho	Construction of Willow Creek 41 cfs. concrete pumping plant and appurtenant structures near Middleton, Idaho.
Aug. 15	Central Valley, Calif	15-ton warehouse crane for Tracy pumping plant.
Aug. 15	Colorado-Big Thompson, Colorado	75-ton crane for Estes power plant.
Aug. 15	do	50-ton crane for Marys Lake power plant.
Aug. 15	do	Construction of Loveland-Greeley 115-kilovolt transmission line (30 miles).
Aug. 15	do	Installation of overhead ground wire, Brush-Sterling 115-kilovolt transmission line (35 miles).
Aug. 15	Columbia Basin, Wash	De-icing motor-generator sets for Grand Coulee power plant.
Aug. 15	Davis Dam, Ariz.-Nev	Construction of 30 miles of 115-kilovolt transmission line from Coolidge Dam to substation ED5 near Eloy, Arizona; wood poles, overhead ground wires.
Aug. 15	do	Stilling well piping for Davis Dam.
Aug. 15	Missouri Basin-Angostura, S. Dak	Stilling well piping for Angostura Dam.
Aug. 15	do	50- by 30-foot radial gates and embedded anchorages for Angostura Dam.
Aug. 15	Missouri Basin-Kortes, Wyo	Stilling well piping for Kortes Dam.
Aug. 15	do	Crane for Kortes Dam.
Aug. 15	do	Generator protective equipment and power cables for Kortes power plant.
Aug. 15	Missouri Basin-Savage Pumping Unit, Mont	Construction of 42 cfs. pumping plant, canals, and laterals on Yellowstone River near Savage, Montana.
Aug. 15	Missouri Basin, Nebr.-Colo	Construction of Sterling-Sidney 115-kilovolt transmission line (40 miles).
Aug. 20	Davis Dam, Ariz.-Nev	Oil circuit breakers for Coolidge substation.
Aug. 20	do	Oil circuit breakers for Blythe substation.
Aug. 20	do	Transformers and oil circuit breakers for Prescott substation.
Aug. 20	do	Unit type substation for ED 2 substation.
Aug. 20	do	Unit type substation for ED 4 substation.
Aug. 20	do	Unit type substation and oil circuit breakers for ED 5 substation.
Aug. 20	do	Unit type substation and oil circuit breakers for Maricopa substation.
Aug. 20	Fort Peck Power, Mont	Transformers, lightning arresters, oil circuit breakers, fuses, disconnecting switches, instrument transformers, for the Circle substation.
Aug. 20	do	Transformers, oil circuit breakers, disconnecting switches, lightning arresters, fuses, instrument transformers, for the Wolf Point substation.
Aug. 29	Central Valley, Calif	Excavation, concrete footings, and gravel surfacing, Keswick Switchyard at Keswick Dam.

Photo by William S. Russell, Region III

Ancient But Active

Around the farm of R. A. (Pete) West in the Muddy River Valley of Southern Nevada are tractors, trucks, and all the modern paraphernalia necessary for irrigation farming, but the water from the Muddy River which makes his irrigated acres rich with growth is delivered by a device which reaches back to the dawn of history—a water wheel. This 38-foot water wheel, creaking on its wooden bearings, lifts water 30 feet for distribution on the West fields. The Bureau of Reclamation is conducting an investigation to determine the feasibility of a project which will give the farmers of the Muddy River Valley a more stable water supply for irrigation.

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1947

Featuring:

Builders of a Nation
by
sst. Commissioner
ENNETH MARKWELL

prinkler Irrigation in the Willamette Valley
by K. W. Sawyer

iver-Size Canal
by
Wafford Conrad

THE Reclamation ERA

Engineer Jackson Looks Back

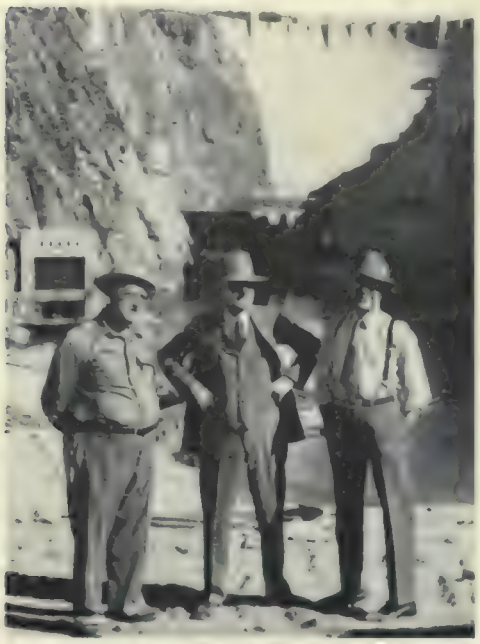

Photo by Wm. S. Russell, Region III

Engineer Jackson (left) talks it over with two of the original crew, Walker R. Young (center) and Tom O'Neil (right).

"There's not much more than a foot or two of this ground I haven't covered and mapped . . . from Boulder Canyon to a few miles below the damsite," reminisced Engineer C. M. (Jack) Jackson as we stood at the turn of the road leading to Hoover Dam power plant and looked over the surrounding tumble of rocky canyons.

"It was in 1922 that I first came out to this section on survey work for the Bureau of Reclamation, and now, 25 years later, all that's left of my job here is to have that pile of old lumber over there cleared away." Jack grinned to belie the sentimental sound of the words, but his eyes showed a proud satisfaction.

"Those days in the early twenties were pretty rugged. The heat and the wind and the sand fought a mighty battle for superiority and almost won. The practically naked bodies of the crew were raw from the wind whipping sand into flesh already tender from the sun. The cook's helper never set the table until after the mess call and even then the men had to wipe the sand off their plates before eating. Nights were stifling. The men dipped their sheets in the river and rolled themselves into the wet sheets for some relief. A couple of young rookies from the East were told that with the rapid evaporation in the desert there was danger of their bodies freezing in the wet sheets . . . but the joke didn't last many nights."

For the past 3 years Mr. Jackson has been construction engineer for the Government in charge of river channel and tunnel improvement at the Boulder Canyon project. Now this job has been completed and he will take his talents elsewhere, leaving a work which has been his prime interest for most of the past quarter of a century.

As he was supervising some of the clean up work on the job, I learned that he comes from Maine and noticed he retains a "Down East" accent, although his appearance is more typical of the land of his adoption.

A large man, Jack's thatch of white hair is in colorful contrast to his bronzed features, and his blue eyes encompass the horizon in the way of sailors and engineers. Having received his World War I discharge in San Diego, ex Marine Jackson decided that his first glimpse of the West held

(Continued on next page)

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Reclamation ERA

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Ruth F. Sadler, Editor

Our Front Cover

Dave Frost, irrigating a section of his 40 acres of alfalfa on his farm near Meridian, Idaho, beats the forces of gravity with the aid of a portable canvas dam. When water goes downhill too fast to do any good, Frost merely locates his damsite, and drops his canvas diversion dam into the lateral until the water is high enough to permit diversion to his fields. This photo was taken by Philip Merritt of Region 1, Boise, Idaho.

Letters to the Editor

Hudson Bay Customers Only

CRESTON, BRITISH COLUMBIA,
CANADA, MARCH 27, 1947.

DEAR EDITOR: In your March issue under "Miscellaneous Publications—Foreign Entries" you noted an article from the London, England "Engineering" emphasizing that navigation of the Columbia River to its mouth is reserved under the Oregon Treaty of 1846 to British subjects.

I quote hereunder the clause in the treaty which refers to this—

"From the point at which the 49th parallel of north latitude shall be found to intersect the great northern branch of the Columbia River, the navigation of the said branch shall be free and open to the Hudson's Bay Co., and to all British subjects trading with the same, to the point where the said branch meets the main stream of the Columbia, and thence down the said main stream to the ocean, with free access into and through the said river or rivers; it being understood, that all the usual portages along the line thus described, shall in like manner be free and open.

"In navigating the said river or rivers, British subjects with their goods and produce, shall be treated on the same footing as citizens of the United States; it being, however, always understood that nothing in this article shall be construed as preventing, or intended to prevent, the Government of the United States from making any regulations respecting the navigation of the said river or rivers, not inconsistent with the present treaty."

You will note from the foregoing that this right of navigation is limited to those British subjects trading with the Hudson's Bay Co. as well as to the company's own servants.

Yours truly,

GUY CONSTABLE,
President, Kootenay Valley Associated Drainage Districts.

¶Many thanks to reader Constable for his interesting historical commentary on the rights possessed by British subjects to navigate the Columbia River.—Ed.

Interest Abroad Continues

BRNO 19, *June 1947.*

GENTLEMEN: I have subscribed to RECLAMATION ERA for a year and I have received the numbers from May 1946 to April 1947, with exception of the June number, which has not reached me.

To complete your worthy magazine I beg you to send me the missing number of June 1946.

The subscription of $1.50 for the next year of the RECLAMATION ERA beginning with the number May 1947 I shall send you in a short time through my son:

Jan Bazant, Jojutla 55, Mexico, D. F.

Yours very truly,

JAN BAZANT
Professor Techn. College,
Brno, Veveri 95, Czechoslovakia.

Engineer Jackson

(Continued from preceding page)

enough attraction for him to make his working career in this part of the country.

After his survey job for the Bureau on the Colorado River, in 1922, he transferred to the Umatilla Rapids in Oregon, working on the location of the canal. The following year, 1924–25, was spent with the Forest Service, his only break in service with the Bureau. Back again to reclamation, he worked in Berkeley, Calif., and Ellensburg, Wash. The years from 1929 to 1935 found him on preliminary work and construction at Hoover Dam, after which he transferred to the All-American Canal at Yuma, Ariz., until 1938. Next came Shasta Dam at Redding, Calif., where he spent 6 years before returning to the Boulder Canyon project.

Flipping his cigarette over the parapet and shielding his eyes from the glare of the desert sun on the face of the dam, Jack murmured with feeling, "There may be mightier and bigger dams built, but she's the baby that'll show 'em how!

"In 1929 I came out here again on preliminary work which was being supervised by 'Brig' Young (Chief Engineer Walker R. Young). I have good reason to remember the famous incident about finding diamonds in the canyon. As a matter of fact, I was working on the shift that found the diamond drill bit, looking exactly the same as it did the day it was lost, and none the worse for its ten-year bath. (Editor's note: see July *Reclamation Era*, p. 162.)

"In 1930 the site of the early construction camp 'Rag Town' was picked out and in 1931 the first contract of the Boulder Canyon project was let . . . the building of a road between the new campsite and the damsite. I was resident engineer on this contract and occupied one of the first twelve houses built in Boulder City by the Bureau for its employees. Dave Armstrong is the only other employee now here who moved into the first of those houses."

We walked back to the car to drive through the vehicular tunnel which makes it possible to get equipment and supplies to the power plant without using the 150-ton carriage which swings from the high line hundreds of feet above the power plant.

I was surprised to find the tunnel nearly a half mile long and to learn that there are approximately 90 tunnels honeycombing the dam and its abutments, one of which runs under the dam through the original rock.

Our time growing short, we started back to Boulder City along the road familiar to all those who have visited the dam. Snatches of conversation from Jack gave me a series of pictures not so familiar . . . of the bighorn mountain sheep which could be seen in the cool of the evening in the early days . . . of the old mine which a prospector had worked as far back as 1880 . . . of the burro trail to the river . . . of the silver and copper strain believed to be in the hills through which the road ran . . . of the hill in Sullivan's Gulch where the Indians mined turquoise . . . of the pure alum to be found in the hills . . . and the tracks of one of the busiest railroads in the country from 1930 to 1935 during the construction of the dam.

I saw the achievement of Hoover Dam in the comparatively short years from the time Jack had worked with a small crew in the hills, with not so much at 50 feet of rope to start operations, to the present magnificent structure.

Tom O'Neil, who is on the janitorial staff of the Bureau, and Jack are the only remaining members of that early group still employed by the project. Tom was a cook for the first crews, and according to Jack, "a darn good cook at that."

The bronze tablet, which stands at the entrance of the Arizona elevator tower commemorating the original field staff, lists the name of C. M. Jackson, the last engineer left of that staff in the Boulder Canyon project. With his departure, Boulder City will be minus a colorful personality, but he leaves many traces of his sojourn there—enduring marks of engineering skill on the structure of which he is so proud—Hoover Dam.

ANCIENT WATER CODES

—by Charles E. Cone,

Research Assistant, Columbia Basin Commission

Hammurabi, sixth king of the First Dynasty of Babylon, reigned for 55 years about 2250 B. C. His elaborate code of laws dealing with many angles of human relations included some water laws which are significant in our present plans for the use and control of rivers.

Hammurabi gave men and beasts first rights to water. Water for household use was second. Irrigation was third; navigation, fourth.

Hammurabi also decreed the penalties for wasting water to the damage of a neighbor's crops or property. Paragraphs 53–56 from *The Code of Hammurabi* read as follows:

"If a man neglect to strengthen his dyke and do not strengthen it, and a break be made in his dyke and the water carry away the farm land, the man in whose dyke the break has been made shall restore the grain which he has damaged.

"If he be not able to restore the grain, they shall sell him and his goods, and the farmers whose grain the water has carried away shall share (the results of the sale).

"If a man open his canal for irrigation and neglect it and the water carry away an adjacent field, he shall measure out grain on the basis of the adjacent fields.

"If a man open up the water and the water carry away the improvements of an adjacent field, he shall measure out 10 GUR of grain per GAN."

About 2000 B. C. Queen Semiramis, an Assyrian ruler, extended her reclamation activities to Egypt as indicated by the proclamation on her tomb:

"I constrained the mighty river to flow according to my will and led its waters to fertilize lands that had before been barren and without inhabitants."

Perhaps some of our modern statesmen could achieve political immortality by earning the right to make a similar proclamation.

—by Fanny R. Connolly,

Region III, Boulder Canyon Project Boulder City, Nev.

The author is compensation clerk with the Bureau of Reclamation, in the safety office of the Boulder Canyon project in Boulder City, Nev. She worked 2 years for the "Detroit Times" and spent 10 years as personal secretary to Walter P. Chrysler. Coming West with her family because of the health of her daughter, she received her first appointment in Government work in 1945, being reports officer at Poston, Ariz., a W. R. A. Japanese relocation camp. After the liquidation of that center, she was transferred to the Boulder Canyon project. Her duties include the publishing of an 18-page mimeographed monthly magazine, the "Safety News," for which this article was originally written. She was born July 18, 1905, in Brooklyn, N. Y., and now lives at 1333 Denver Street, Boulder City, Nev., with her husband and two children.

Builders of a Nation

Photo by Stanley Rasmussen, Region 1

The chatter of jackhammers—prelude to Cascade Dam, Idaho

There is a common bond between the Bureau of Reclamation and the workmen of America. For without the skilled help of the men operating the bulldozers and draglines and the men on the factory production lines, such magnificent structures as Hoover, Shasta, and Coulee Dams would have remained blueprints on engineering drafting boards.

by KENNETH MARKWELL,
Assistant Commissioner.

The following article is based on an address prepared by Mr. Markwell and presented by Glenn D. Thompson, chief personnel officer of the Bureau of Reclamation, before the American Federation of Labor Council, on Tuesday, July 8, in Washington, D. C.

Approximately 100 of our projects now constructed or being built in the 17 western States, where water is the measure of prosperity, represent the combined efforts of men in the Middlewest, the North, the East, West, and the South. Although these irrigation and multiple-purpose projects are located in the West, their construction creates job opportunities from Maine to California.

For every man on the construction site there are several helpers thousands of miles away. The off-site workers produce the materials needed for building. They manufacture such basic products as iron and steel, cement, electrical equipment and supplies, foundry and machine shop products too numerous to list. Much of this work is done in the 31 States outside of the 17 irrigation States of the West.

These supplies from their beginnings as raw materials, their transportation to the factory for fabrication, their processing, and again their transportation to the place where they are used, require thousands of man-hours of labor in mines, forests and factories, and in transportation, distribution, and administration.

The start of one of our projects in Arizona, or California, the State of Washington, or in one of the other States where Reclamation since 1902 has been responsible for water conservation and use, sets up a chain of employment that produces economic reactions across the continent.

Cross-Country Combine

We can visit almost any part of the United States and find workers turning out materials for dam, canal, and power-plant construction. To cite only a few examples we find men in New York State making cranes; perhaps for placing concrete blocks in a dam now rising from a western river bed. In Baltimore, Md., as well as in Alabama and Indiana, they are fabricating high-pressure gates and valves to operate irrigation distribution systems. Workmen in the New England States are producing assorted electrical equipment which will travel far before it is put to use for the first time.

Generators come from Milwaukee. Then in Virginia they make hydraulic turbines. Ohio and Indiana supply road machinery and draglines. The mines of Colorado, Ohio, and Pennsylvania turn out coal, and the Mesabi Range of Minnesota produces the iron for building many Reclamation structures in the West. The South yields cotton for making tarpaulin and miles of wire braiding. Lumber also comes from the South as well as from Washington State and Oregon. Subcontracts for special castings are filled in the Southeast, and orders for iron and steel fabrication are delivered by the Middle Atlantic States.

Thus workmen from every part of America contribute their part to the construction of great irrigation and power projects that are laying the foundations in fertile river basins for the increasing security of the Nation.

Completion of Reclamation projects does not mean the end of employment opportunities. Rather it is just the beginning. For there are jobs on new irrigated farms—farms where veterans are anxious to settle and rear their families—there are new open-

ings for business and professional people in communities serving these rural homes—doctors, lawyers, dentists, school teachers, home-town merchants—all of these are needed with the growth of Western population. There are jobs in food processing plants and in other industries in towns that thrive with the development of low-cost power.

What of the rest of the country? Here, too, employment increases even after Reclamation projects are completed. The farmer can buy what he needs with money from his crops—and he makes good money—last year, farmers on 5 million acres of land irrigated by Reclamation-served projects produced 12 million tons of food and fiber crops worth a half billion dollars. This amount for 1 years' crops, incidentally, is far greater than the cost of irrigation facilities serving the lands.

What happens to Western dollars? Many of these silver cartwheels roll eastward where they are exchanged for tractors and refrigerators and other farming and household equipment. This is a reciprocal type of prosperity that helps America. It is an example of one part of the Nation bulwarking the other parts and the whole benefiting by the solidarity of the structure.

I do not mean to imply that we are in the business of creating jobs. Employment opportunities are a result rather than a reason for Reclamation construction. Our job is to see that the Western farmer gets water to grow crops. The primary purpose of the Bureau of Reclamation is the conservation of water and land resources to turn nonproductive lands into wealth-producing, tax-bearing communities and self-supporting farms for veterans and others. Because of its long-range view, our program is an economic stabilizer instead of a stop gap for a possible depression period.

In addition to supplying irrigation water, hydroelectric power, flood control, navigation improvement, recreational benefits and other multiple purposes of a project, the results from Reclamation include not only good homes and jobs, but better nutrition for the Nation.

People in the East would be hard put for winter vegetables and fruits were it not for the shipments of lettuce, tomatoes, and citrus fruits from the winter gardens of the West. The supply of meat in the national market may rise and fall with the production of alfalfa hay and sugar beets on irrigated farm lands. Sugar beets not only yield large quantities of domestic sugar but their tops and pulp are valuable stock feed.

It is indeed a miracle that a part of the country which was once labeled as "The Great American Desert" is now one of our greatest food producing centers. Irrigation has wrought the change.

I have mentioned that irrigation is the first purpose of a Reclamation project. Power, a corollary development, has a special place in each of the Reclamation river basin designs, such as the Columbia, the Missouri, the Colorado. Power also has a

Photo by F. B. Pomeroy, Region I

Eastern product being unloaded at Grand Coulee Dam, where this water wheel from Newport News, Va., will drive the world's largest hydroelectric generator.

place in some 20 more major plans now in the blueprint stage. River power not only pumps water, lights homes, eases the drudgery of farm life, and spark-plugs industry, but in so doing it makes itself a very valuable financial asset to Uncle Sam. The sale of low-cost power pays all power construction costs and helps to pay irrigation costs of a project. This salability of power consequently lowers the cost of water to the irrigationist.

Sharing Dividends

Reclamation projects are not give-away propositions. Under the law, the cost of irrigation and power works—that is, the money advanced by the Federal Government through appropriations—must be repaid to the Treasury. Power rates are established so that the cost of the power development is returned to the Treasury with interest at 3 percent. Also irrigation costs that are beyond the repayment ability of the irrigation water user are returned from power revenues. Under our present laws, the interest paid for the Government money on the power investment may be applied to the irrigation cost if needed. This is right and proper because the indirect benefits to the Nation from the land made highly productive by irrigation far exceed the costs. Navigation and flood control features, of course, are not directly reimbursable to the Treasury.

In the East, it is hard to realize that there are parts of the country where rainfall is not plentiful or well-distributed throughout the crop-growing season. Without water-conservation projects, the natural resources of one-third of our country would remain undeveloped with a consequent loss of markets, of employment opportunities, and taxable wealth for the Nation.

Of the 750 million acres in the West, 21 million acres are now irrigated. Only about half of these irrigated acres have enough water. It is estimated that our western rivers and tributary streams can supply sufficient water to irrigate an additional 22 million new acres and to provide additional water for the 11 million acres now inadequately served.

Unfortunately, we will never be able to develop and irrigate more than 6 percent of the West because there isn't enough water to go around. It is a case of trying to make a fair apportionment so that more people will have a chance for prosperity. That is basic in the Reclamation creed—conservation and wise use of water for the benefit of the greatest number of people.

This policy of trying to serve the people also applies to power. So long as the Government sells hydroelectric energy over Federally built transmission lines to the consumer, there is the assurance of the little man getting the power he needs and at a very reasonable cost.

Forty-five years of Reclamation have proved the worth of building projects for the people. We have a good foundation for future building. We need everyone, especially the workmen of America, to help us roll forward.

More Money for Missouri Basin

When President Truman signed H. R. 4347 on July 31, the bill providing for supplemental appropriations during the fiscal year of 1948, an additional $6,400,000 was made available for Bureau of Reclamation construction in the Missouri Basin.

These funds will be used to step up construction on 2 dams now under way and to initiate early construction on 11 others. The 13 locations, and the amounts appropriated for work on each under the terms of the bill are as follows:

Bixby, S. Dak., $500,000; Bonny, Colo., $800,000; Boysen, Wyo., $700,000; Cannonball, N. Dak., $400,000; Cedar Bluff, Kans., $900,000; Culbertson, Nebr., $300,000; Enders, Nebr., $700,000; Heart River, N. Dak., $400,000 (for Heart Butte and Dickinson Dams); Keyhole, Wyo., $200,000; Moorehead, Mont., $900,000; Narrows, Colo., $300,000 and Shadehill, S. Dak., $300,000.

In his message to Congress requesting funds for flood control, President Truman said:

> Vast areas of the most productive sections of the Missouri and upper Mississippi River Valleys have been subjected to a series of the most destructive floods in our history. Measures for flood control should be integrated with plans for the use and conservation of water resources for other purposes. This will insure maximum control of floods at the least cost and will permit the full utilization of water resources in the development of this vast region.

Sprinkler Irrigation in the Willamette Valley

Man-made rain is produced scientifically, on schedule, and according to specification in this section of Oregon.

by K. W. Sawyer, *Manager, Agricultural Department, Portland Chamber of Commerce*

Several weeks ago, Weather Bureau officials, with the aid of airplanes and "dry ice," created an artificial snow storm over an area a few miles east of Portland, Oreg. Farmers, with the aid of agricultural engineers and equipment manufacturers, have been creating artificial rain over Willamette Valley farms for the past 15 years. The man-made snow storm was purely a matter of experimentation. Man-made rain is no longer a matter of experimentation—it is an accomplished fact—practiced regularly on approximately 45,000 acres of Willamette Valley land.

Oregonians are referred to the Nation over as "Webfeet." This gives the impression of continual rain—an impression that is not entirely true. Annual precipitation averages about 40 inches throughout the Willamette Valley in western Oregon. The highest precipitation is recorded throughout the winter months. While spring and fall recordings are considerably lower, the maximum low is recorded during the summer. During the growing season, from May to October, there falls only about 9 inches of rain. In the months of June to September, there is only about 3 inches of rain. It is during these 3 dry months that farmers must turn on their artificial rain if they are to grow certain high-value, intensive crops, and if they are to get maximum yield and quality of some extensive crops.

The Bureau of Reclamation bulletin "Farmer's Irrigation Guide" devotes some 40 pages to an explanation of irrigation methods and practices most widely used on reclamation projects. These methods are: (*a*) corrugation or furrow, (*b*) border or strip, and (*c*) ridge or bed systems. The bulletin concludes by listing 8 sound rules to follow, including among others the rule: "Irrigate your crop, don't drown it. Control the water flow, don't leach or erode your soil." These methods of irrigation presuppose an adequate volume of water above the land to be irrigated, or in other words, an extensive canal system, and land reasonably level to permit surface irrigation.

Right where this bulletin stops is where sprinkler irrigation, as practiced in the Willamette Valley, starts. There are no canals to carry water to the land; the source is from streams, ponds, or wells, always below the level of the land to be irrigated. Often the volume of water is limited and the land is too uneven to permit economical leveling for surface irrigation. Advantages over surface irrigation may be listed as follows:

(1) More efficient use of water—saves one-half to two-thirds of the water otherwise necessary.

(2) Complete control of water at all times, eliminating leaching and erosion.

(3) Uniform application of water over an entire field regardless of soil type or topography.

(4) No expensive leveling or grading.

(5) No ridges, rills, or ditches to farm over or around.

Proponents of sprinkler irrigation feel that its advantages will result in its wide use on reclamation projects—especially where water supply is limited and where soil type and topography make complete control necessary. Others will contend that power and equipment costs make it impractical. However, it is not the purpose of this article to argue the merits or demerits of either system.

A wide variety of field crops and fruits adapted to the temperate zone have been grown in the Willamette Valley for the past century. A stable and highly diversified agriculture has developed without irrigation. Why, then, should farmers expend money and labor to irrigate? Those 3 dry months, while being ideal to mature and harvest certain crops, make it impractical or impossible to grow other crops. Crops which could not be grown successfully are, for the most part, those which produce a high per acre return. Two in particular—ladino clover and improved grass pastures—have been badly needed by the dairy industry. This is where progress was made back in the early 1930's. It was at about that time that the Oregon State College became active in promoting sprinkler irrigation for pastures. It was also at about that time that equipment manufacturers started making improvements resulting in greater efficiency of pumps and entire systems. Latest improvements are light aluminum pipe with self-locking couplings, and sprinkler heads designed for the particular job.

According to latest estimates, there are approximately 60,000 acres of irrigated land in the Willamette Valley with three-

The Bureau of Reclamation is analyzing the development of sprinkler and pipe irrigation and is now studying the types best suited to serve its projects in the western States.

On existing projects water may be pumped to the higher lands for pipe delivery, thus supplementing the supply to land served by gravity from open canals and laterals. Pipe irrigation may result in substantial savings from seepage. In addition, sprinkler irrigation can be used to irrigate lands within a farm that are impractical to irrigate by gravity from open canals and laterals, such as lands with a rolling terrain which may be irrigated by sprinklers without leveling the land and disturbing the topsoil.

The Bureau will report on both portable and permanent pipe systems. Information will be collected on installation and operation costs, labor requirements for operation, pumping requirements, useful service life, application rates and water supply requirements for various soils and crops, sprinkler effects on soils and crops, water savings, evaporation losses, and layouts and operation data of successful systems.

Sprinkler system in action. In the foreground—summer squash; center—land being readied for lettuce; background—cucumbers.

fourths, or 45,000 acres of the total, under sprinklers. Wartime scarcity of materials and labor brought the program to a virtual standstill. At the present time, equipment is coming into good supply and acreage is expanding rapidly. To predict a stopping point in this development would be pure speculation. However, there are certain factors which will have their effect on ultimate total acreage.

Plenty of Water

It has been estimated that water is available for upwards of 100,000 acres without benefit of storage or distribution facilities. Therefore, water supply is not an immediate limiting factor, except as it applies to a particular tract of land.

Approximately one-third of the total acreage is devoted to ladino clover and improved grass pastures; one-third to vegetable crops for processing; one-third to various specialty crops and extensive field crops.

The current outlook for dairy products seems to warrant any expansion that can reasonably be expected. Up to three cows per acre can be carried on good irrigated pasture. Production can be maintained at a high level throughout the pasture season. One cow for each 3 acres is about the limit without irrigation. Therefore, a substantial increase in irrigated pasture can be expected.

The one-third of the total acreage which is devoted to vegetable crops for processing is the basis for a multi-million-dollar food canning and freezing industry. Green beans, sweet corn, beets, and carrots, are the major crops in their order of importance. The volume of such products which can be absorbed by the market at fair prices seems to impose a limiting factor on expansion of acreage devoted to these crops.

As to the other one-third, devoted to specialty crops, fruit crops, nuts, and some extensive field crops, future development of sprinkler irrigation seems to become a matter of economics. With the possible exception of mint for oil and a few others, most crops in this group can be grown without irrigation. The amount and value of crop increase due to irrigation, weighed against its cost, will determine the extent of acreage increase.

Regardless of these factors, the rain makers, during 1947, will probably have their biggest year to date.

While sprinkler irrigation is way past the experimental stage, it is far from being standardized. In fact, it never can be standardized so that a farmer can go to his dealer, purchase and take home a system to install on his farm. Every installation must be tailored to fit the job. Volume of water available, acreage and kind of crop to be covered, total lift, and other factors must be carefully determined to do the "tailoring" job. The equipment manufacturer or distributor, electric-power companies, and county agricultural agent offices are all qualified, ready and willing to provide the essential technical help.

Individual Ownership

Each system is purchased, owned, and operated by the individual farmer—there being no district organization involved. No one can deny the fact that it is expensive to install such systems; but so is it expensive to build canals, level land, and lay out surface irrigation systems. Costs will range from $50 per acre for an ideal situation to as much as $100 or more—depending upon the factors involved and whether the farmer wants and can afford the very best type of installation. Therefore, a system to irrigate 30 acres might cost $1,500 to $3,000 or more. The crop to be irrigated will also have an effect on costs. A system which would prove satisfactory for pasture where it can be operated continuously throughout the season, might not be at all satisfactory for intensive vegetable crops where a larger volume of water is necessary so as to get over the field quickly.

A trip through the Willamette Valley during the coming summer will reveal local "showers" falling without a cloud in the sky; tons of water flowing up hill to be spread through whirling sprinklers; and crops, untouched by drought, yielding six times more than adjacent fields. Artificial rain no longer has to be "sold" to farmers of this area. It is an important factor in our highly diversified and rapidly expanding agricultural economy.

The author is indebted to R. M. Wade & Co., Portland, Oreg., for photographs and other material contributed for this article and to the Oregon State College Extension Service, Corvallis, Oreg.

Lack of Precipitation

A couple from the East were touring the West one summer.

Driving along the road in an irrigated district they noticed a farmer throwing buckets of water out of a barrel onto the roof of his house. They stopped and watched this unseemly procedure in amazement. Finally their curiosity got the best of them and they walked to the farmhouse.

"If you don't mind my asking," said the Easterner, "what the Sam Hill are you doing that for?"

"Well, stranger, I built this here house four years ago, and I'm just trying to find out if the roof leaks."

Reclamation's Construction Program

Irrigation water for 192,000 additional acres of Western farm lands and an increase of 574,000 kilowatts in hydropower capacity is the goal of the fiscal year 1948 Bureau of Reclamation work program, Commissioner of Reclamation Michael W. Straus announced after a 5-day programming conference of top-ranking Bureau officials at Salt Lake City. Secretary of the Interior J. A. Krug participated in the conference.

Nearly 50,000 acres of public lands are expected to be opened for settlement and other settlement opportunities will be available on privately owned lands.

Adjusted to appropriations recently made by the Congress, the 1948 construction schedule is the first leg on a Bureau of Reclamation program to push authorized projects to the point where by 1954 irrigation water can be supplied to 3,875,000 additional acres of land which constitute about 40,000 farms, and new capacity of 2,250,000 kilowatts of hydropower will be installed.

The Reclamation construction program in 17 Western States for the fiscal year ending June 30, 1948, amounting to $195,000,000, will operate on a "full speed ahead" schedule to use most efficiently the available funds, the Commissioner said.

Full-year construction is forecast on all but five major projects during the current fiscal year. The appropriations plus carryover of 1947 funds on these—Columbia Basin and Yakima-Roza in Washington, Colorado-Big Thompson in Colorado, Davis Dam on the Arizona-Nevada border and Central Valley in California—will be insufficient to meet anticipated earnings by contractors for the full year on contracts already let, it was pointed out.

"The full prosecution of this program will require supplemental appropriations amounting to $36,000,000 early in the next session of the Congress, beginning in January," the Commissioner explained.

Any carry-over of funds into 1949 fiscal year will be due to certain projects where local conditions may make it uneconomical or impossible to carry construction forward.

Reclamation funds are appropriated to definite projects, it was explained, and they cannot be interchanged among the projects. This may create a situation of a deficiency of funds on some projects and carry-over on others, it was pointed out. Furthermore, allocations for specific projects or features of projects may be adjusted in order to conform with construction progress.

In conjunction with the 1948 construction program, 27 repayment contracts with irrigators are scheduled to be worked out. A major problem in programming the construction schedules was created by the limitation placed in the appropriation act on personnel engaged in design and specification work in the Denver engineering offices. This makes necessary delegation of certain design and specification functions to projects, with loss of time and additional expense. Another limitation on force account work, the Commissioner said, will sharply curtail activity in certain cases where the normal contracts cannot be readily used.

In the Missouri River Basin, in addition to dam construction, irrigation features will be continued under the regular appropriation act. In addition, $4,800,000 will be available to complete detailed investigations and preconstruction work to bring new units to the construction stage in the Basin. The Missouri Basin program also includes $2,600,000 for construction of transmission lines to deliver power to construction sites and to publicly owned power users in critical power areas.

The $195,000,000 program includes, in round figures, construction expenditures for the following major items:

REGION I (HEADQUARTERS, BOISE, IDAHO)

Idaho

ANDERSON RANCH DAM: $3,370,000; resume dam construction on full schedule to limit of funds.

BOISE PROJECT, PAYETTE DIVISION: $1,175,000; construction on Cascade Dam and clearing of reservoir site; canal and laterals construction.

LEWISTON ORCHARDS: $500,000; initiate and substantially complete reconstruction of existing irrigation system.

MINIDOKA: $500,000; construction on canal and laterals and establish farm units.

Idaho-Wyoming

PALISADES: $780,000; continue detailed investigation and development studies.

Montana

HUNGRY HORSE DAM: $2,900,000; start dam and reservoir construction; award turbine and generator contracts.

Oregon

DESCHUTES: $3,400,000; continue clearing Crane Prairie Reservoir site and construction of North Unit Division including Wickiup Reservoir; river channel improvement; complete canal and work on laterals. Emergency rehabilitation Arnold irrigation district siphon.

OWYHEE: $200,000; complete work on canal system.

Washington

YAKIMA: $3,050,000 (including supplemental appropriation needed); continue pump and lateral construction on Roza Division.

COLUMBIA BASIN: $32,000,000 (including supplemental appropriation needed); no new contracts, but continue on all existing contracts until funds are expended. Complete installation of three generating units in left powerhouse and work on auxiliary features such as the switchyard. Suspend work on main pumps and motors for irrigation system. Continue construction of Potholes Reservoir and the main canal system including Long Lake Reservoir.

REGION II (HEADQUARTERS, SACRAMENTO, CALIF.)

California

CENTRAL VALLEY: $40,380,000 (including supplemental appropriation needed) virtually complete installation of drum gates, penstocks, and two generators in Shasta Dam, and of gates and other appurtenances on Friant Dam; install two generators at Keswick Dam; virtually complete construction on Contra Costa, Clayton and Ygnacia Canals and expedite construction on the Delta-Mendota and Friant-Kern Canals including new contracts; construction Tracy pumping plant; construction of part of two transmission lines and start of work on a tapline.

KLAMATH: $1,680,000; complete Adams pumping and construction of canal and other irrigation facilities, and flood protective works. Open almost 10,000 acres to settlement.

REGION III (HEADQUARTERS, BOULDER CITY, NEV.)

Arizona

GILA: $2,190,000; complete contract on major construction of canal and laterals for Yuma-Mesa Division; predevelopment work on farm lands; initiate Welton-Mohawk Division preconstruction.

California

ALL-AMERICAN CANAL; IMPERIAL DIVISION: $340,000; repairs to dam and desilting works Coachella Division, $6,150,000; construction of main canal, as modified; start on distribution system in Coachella Valley and advance flood protective construction.

Arizona-California

PARKER DAM: $140,000; final minor construction on dam powerhouse and transmission plant to be completed.

Arizona-Nevada

BOULDER CANYON: $630,000; drilling, grouting and miscellaneous operations including drainage system.

DAVIS DAM: $20,670,000 (including supplemental appropriation needed), reduced scale construction of dam and transmission until available funds are exhausted.

REGION IV (HEADQUARTERS, SALT LAKE CITY, UTAH)

Colorado

MANCOS: $1,680,000; construction Jackson Gulch Dam.

PAONIA: $320,000; complete land classification; economic surveys; start Spring Creek Dam and reservoir construction; design work on canal system.

(Continued on page 208)

OWYHEE RESERVOIR

A practically nonexistent "road," a lack of camping facilities, and a rough terrain, only seem to add to the lure of this fisherman's paradise

by Lyle M. Nelson

Director of Information, Oregon State System of Higher Education

Photo by Stanley Rasmussen, Region I

Leslie Gulch empties into Owyhee Reservoir, 40 miles above the dam.

A band of wild horses scampered up the draw and out of sight over the canyon rim. In full view was the lake—a narrow body of water, hemmed in by steep canyon walls, smooth as glass one minute and choppy with white caps the next.

This was the famous Owyhee Reservoir, home of the fantastic bass which struck at almost anything which disturbed the tranquillity of their mountain fortress. This was the spot proclaimed by many fisherman as one of the best bass fishing areas in the Nation.

But what seemed of even more importance at the moment was the spectacular beauty of little-known and less-explored Leslie Gulch. Located in the famous Owyhee breaks region of southeastern Oregon—one of the few primitive areas still remaining in the Nation—Leslie is reached from the one-family town of Rockville, Oreg., by 22 miles of what, with some stretch of the imagination and an apathy to overstatement, might be called a road.

The "road" is not shown on highway maps. In omitting it, the map makers have done the public a favor. It is little more than a trail hacked out of sagebrush, around boulders too big to move, and up and down dogpatch-type "onnecessary" mountains. Its inaccessibility, however, has not kept its fame from spreading.

What tremendous values accrue to a region, from a recreational standpoint as well as directly, is well illustrated by reservoirs such as Owyhee.

In 1946, sportsmen estimated that they took at least 18,000 pounds of cooperative-type bass from the reservoir behind Owyhee Dam. This represented the limit for most of the fishermen who made their way into the area. In addition, several large catches of silver trout were made and limits of crappie virtually caught themselves.

Of equal importance to the sportsman who likes a fight when he hooks a bass, there were plenty of 5- to 7-pound "babies" to churn up the water before being taken. Silver trout, which usually stay in the cool, deep water near the dam, were even larger.

With construction of the dam, hunting in the area also has improved and a sizeable number of sportsmen from Oregon and Idaho now make it their fall headquarters for deer and antelope. In addition, ducks and geese are plentiful on the upper reaches of the reservoir.

A recent National Park Service report of the recreational advantages of the reservoir contains this significant statement: "Fishing is said to be phenomenal . . . because the fish have had an opportunity to adjust themselves to reservoir conditions without any appreciable hindrance from fishermen, they have multiplied until today the reservoir is probably one of the best fishing areas in the region."

The report continues: "It is the belief of fishermen that a great percentage of this resource is going to waste and that the sport actually would be improved if the waters were fished more."

Actually true! Such sportsmen as "Tex" Everhart, one of Idaho's most enthusiastic sportsmen, believe that fishing would be better if the lake were used more extensively. So much so that they are willing to share their secret and their good luck with additional fishermen, hoping in so doing that they will benefit the sport.

"Tex" swears to this story. He says that one day the lake was exceedingly rough and choppy, sending great waves over a shallow sandy beach. "That day we didn't even have to get out our tackle, we just grabbed the bass as they were flung onto the beach."

The fame of Owyhee has spread throughout the Nation. Its visitors last year included fishermen from California, Florida, New York, Missouri, and 2 dozen other States. This year a couple of businessmen are flying in from New York chiefly to fish its waters.

Having tested the fruits of this recreational gem, fishermen form a habit of returning. In the words of Mickie Freeman, an old-time bass fisherman from Missouri, "A large portion of my life has been spent in the middle and far-western States on fishing expeditions with bass as the great

objective. In all my travels and fishing efforts, I have never found a place where bass fishing is as good as it is at Owyhee Reservoir."

"It has been my good fortune," Mr. Freeman continues, "to be at the right spot on that reservoir at the right time and using the right lure with the result that my boat has been weighted heavily with 4- to 6-pound large-mouths and my casting arm tired and sore. . . . Its full advantages will never be utilized until a satisfactory road is built so as to permit sportsmen to enter the reservoir about 40 to 50 miles above the dam. With such a road, I predict that Owyhee Reservoir will soon become the most popular bass fishing spot in the entire Northwest."

There is a fair road to the dam, but from there to the main fishing areas is too far for a day's trip by all but the largest boats.

To take care of the large number of boats being put in at the dam, Superintendent Dick Stockham in his spare time constructed a small hoist from odd parts salvaged after the structure was completed. The hoist has since been taken over and operated by a local boat club.

Stockham, whom sportsmen regard as a friend as well as helpful advisor, is himself an ardent fisherman. On more than one occasion he has come to the aid of a fisherman marooned or hard-put by an unseasonable storm.

The lake is a perfect habitat also for crappies, which are flat and stocky, resembling sunfish. These are so plentiful that fishermen often throw them back so that their limit might be expended in bass. During a single hour, one Sunday in May, 5 Bureau sportsmen caught 50 of the crappies along a stretch of shore not exceeding 100 yards in length. One of these fishermen caught a fish for each of 8 consecutive casts.

The need for a road to the middle or upper end of the reservoir is recognized by the Park Service. In its report, there is a recommendation for investigation of the possibility of establishing an overnight camping area in the vicinity of Leslie Gulch, and of building a road to this location.

Cliff-sheltered Camps

At present, fishermen usually camp out at the mouth of the small draw which leads into Leslie. There are no trees, but the camp is fairly well sheltered by steep cliffs.

When, and if, the road is finally built into Leslie Gulch, the sportsman will be able to bring his entire family for an outing. The remarkable scenery—tall, jagged peaks, unusual and varied formations sculptured out of multicolored rock and earth, caves and Indian writings—has been described as more beautiful than some of the national parks.

Leslie Gulch is an amazing spectacle of erosion, seen by relatively few. As one fisherman put it "All hades must of broken loose here at one time."

Among the impressive sights in the area are jagged pinnacles rising 300 to 400 feet above the canyon floor, and massive Gibraltar-like formations, in brilliant red, forming sheer walls along the reservoir's edge, a thousand feet high. A natural horse corral is formed by a side canyon, into which the bands of wild horses are driven for capture. Mahogany Creek is bordered by scattered junipers and mahogany trees. Lizards, colorful snakes, eagles, hawks, and other birds nest in the crevices of the weird formations. Giant "blow holes" are formed in rows of sharp, rocky sawtooths. Deep, cool caves are carved out of the mountainsides. Rolling hills of blue minerals, sharply accentuated with juts of bright red, and giant vari-colored boulders pockmarked with dozens of sharp openings, add to the spectacular wonders of the area.

For almost all of its entire length, Owyhee Reservoir is confined in a narrow winding gorge between the towering Owyhee Ridge on one side and such peaks as Burnt Mountain and Red Butte on the other. The bold shore line was made to order for camera experts.

It seems as if nature has done its best to hide this precious jewel, tucking it away between two commanding mountain ranges and buffering it with mile after mile of uninhabited sagebrush—the primitive and desolate Owyhee breaks which have served as the locale for many a story about western badmen.

A glance at a good road map probably would scare away the mild adventurer. Such names as "Coyote Wells," "Skull Springs," "Folly Farm," and "Rattlesnake Creek," reflect the nature of the country. In short, it's no place for a tenderfoot nor for a Sunday drive.

Indeed, if a description of Owyhee's scenery were limited to two words these would be "spectacular" and "rugged." Rugged to reach, and cast from a rugged die in nature's workshop, but spectacular once seen.

There are few fishermen who have made the trip who will not agree that the combination of outstanding fishing and inspiring scenery make this materpiece of Reclamation engineering one of the finest recreational spots in the Nation . . . so fine, in fact, that most of them have turned into enthusiastic promoters of the area and of the road which would open it up to countless additional thousands of visitors.

Photo by Stanley Rasmussen, Region 1

Superintendent Dick Stockham's boat hoist, busy since he built it. Earl Ackley and Tex Everhart preparing fish fry at Leslie Gulch.

NEVER Underestimate A BEE

Reclamation officials and other authorities answer the question raised in last month's issue, "Does Beekeeping Have a Part in Reclamation Planning?"

H. A. Bushby, of Star, Idaho, Boise project, puts the bees at ease with smoke treatment before making routine hive inspection. →

Photo by Philip Merritt, Region I, Boise, Idaho

Red Clover stretched in a waving expanse. Twenty-thousand irrigated acres—as pretty a sight as a man could want to see. But the farmers were not happy.

The place was Colorado's lush irrigated Otero County; the time, 1928. Two years before a progressive farmer had decided the climate and soils were ideal for raising Red Clover seed, and every inch of his land went into this crop. He made a killing. The seed sold for 26 cents a pound—better than $180 per acre. The next year his neighbors caught on to what looked like a good thing and the Arkansas Valley communities were prosperous.

But this was the second year—1928. A shocking thing had happened; only the fringe of the huge irrigated Red Clover area was developing properly. The seeds failed to set in the remainder of the crop. Hurried calls to the State Extension Service failed to indicate why the seeds had failed to develop. Within a few days a specialist from the Department of Agriculture in Washington, D. C., was on the site. He looked it over. The Red Clover was beautiful; the plant grew strong and was covered with blossoms; except for the setting of the seeds the crop appeared to be ideal. Why this blight on the seed pack?

The answer, immediately apparent to the Washington specialist, was—*Bees.* In 1926, when the acreage of Red Clover was comparatively small, there were enough honeybees in the valley to pollinate the clover. But when the acreage jumped to 20,000, there was too much ground for them to cover—they couldn't double their numbers or their duties in time to meet the expanded workload.

Since then, irrigation farmers in the Arkansas Valley have held the honeybees in deep respect, and have kept them in mind when expanding acreage or planting new crops.

This is typical of the replies to the question posed by Mr. James I. Hambleton, in charge of bee culture for the Department of Agriculture, who asked, "Does beekeeping have a place in reclamation planning?" in the August issue of the RECLAMATION ERA.

The question was answered by officials in six of the seven regions of the Bureau of Reclamation, who sent in information which indicated that bees are becoming part of irrigated farming just as livestock is looked toward to balance the reclamation farmer's budget.

Region VII summed up the general attitude by reporting that until comparatively recent times the production of honey was considered a minor agricultural activity and the pollination of growing crops by the bees as a minor blessing of nature. Recent experiences, however, are rapidly changing the attitudes of both beekeepers and crop farmers, with particular accent on the latter.

There are about 6,151,000 colonies of bees in the entire country, and according to the 1946 crop report, 1,519,000 colonies (almost 25 percent of the total) are located in 15 reclamation States.

Value of Pollination

Obviously, reclamation farmers, particularly orchardists, are well sold on the value of bees for pollination.

The Regional Director of Region I says, "Bees are highly important in Canyon County, which is one of the outstanding seed-growing counties in Idaho."

Mr. C. F. Webster, associate agent in Reclamation, employed jointly on the Yakima project by the Bureau of Reclamation and the Extension Service, State College of Washington, Pullman, Wash., comments on the economic value of bees, especially the honeybee, by saying "regarding the future of bees in the valley, it might be stated that without bees the Yakima Valley would suffer an irreparable loss."

Region II, with its large package bee business, importation of migratory bees, leading honey production and many bee

(Continued on page 200)

How to Make a Mechanical Post-Hole Digger

By H. H. Kob and O. J. Trenary

Extension Service,
Colorado College of A. & M.

Discovered! A boon to the new settler on a Reclamation project—a machine which takes the labor out of digging post holes!

Mr. Victor Norman, a successful farmer in the Colorado-Big Thompson project, had a lot of post holes to dig each year as a result of rotating his pastures and replacing broken posts on his sheep-tight fences. Norman foresaw many days of back-breaking work, so he applied literally the old adage, "Let your head save your heels," and invented a digger which would operate from the power take-off of his tractor. The machine was a success from the start and Victor Norman says he couldn't farm without it.

The Mechanical Engineering Section of the Agricultural Experiment Station of Colorado A. & M. College has perfected the design for this machine and has brought forth a mechanical device which will bore a post hole 2½ feet deep in less than that many minutes.

This machine, which could be adapted to almost any farm tractor with a power take-off, can be readily manufactured in a good farm workshop or in the community blacksmith shop and would become a favorite "drudge killer" on many Reclamation project farms. On projects where farm units are small, the digger could be built and owned by several farmers. On larger combination range-livestock and irrigation-ranges, its individual ownership will quickly make it an indispensable part of the farm operation equipment. Design of the part and instructions for making the digger are outlined below. Circled numbers and letters on the drawing refer to the following instructions.

1. The principal working parts of this tractor attachment consist of the propeller shaft, differential, and rear axle housings from an old car—in this case a Ford Model A. Following are the changes made on these parts:

(*a*) Completely disassemble the differential.

(*b*) Remove spider and spider gears and replace with a flat steel plate having a 1-inch square hole in the center. This plate must be cut to fit and securely attached to the ring gear with cap screws through the spider bearings.

(*c*) Cut off axle housings.

(*d*) Cut out a portion of the propeller shaft housing from just back of the roller bearing to 18 inches from the differential housing; then weld the two ends back together. Be sure to line them up properly. Finished housing should be 24 inches long.

(*e*) Cut off splined end of propeller shaft, leaving a shaft 32 inches long. This shaft must be set up in a metal turning lathe and a new bearing surface turned to fit the roller bearing at the end of the propeller shaft housing.

(*f*) Cut a key-way in the end of the propeller shaft for ⅛-inch key.

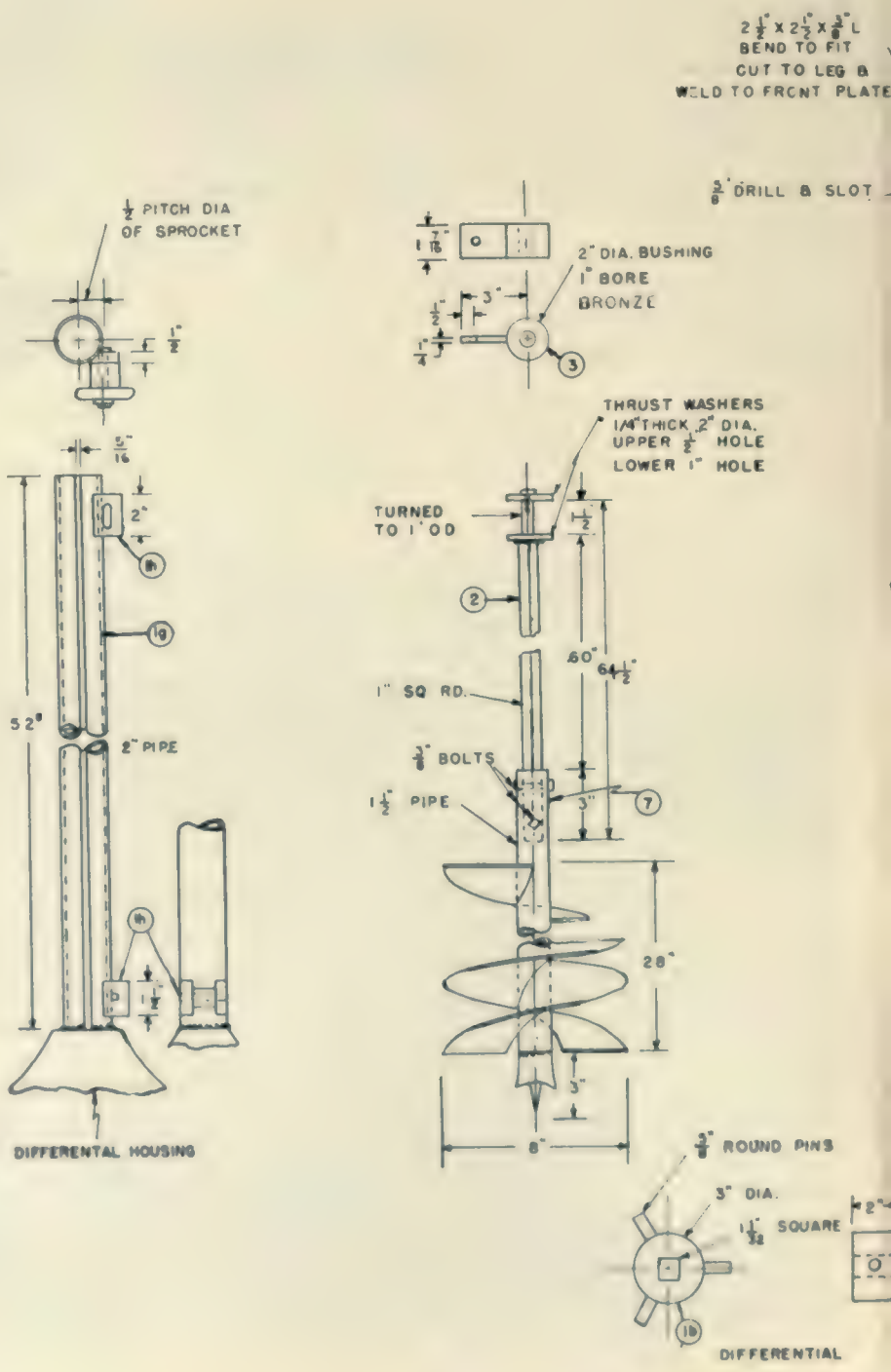
(*g*) Cut a $\frac{5}{16}$-inch slot through the full length of a piece of 2-inch pipe 52 inches long. The pipe should be threaded on one end. Then weld this pipe to end of rear axle housing next to differential, using the end not threaded.

(*h*) Weld onto this pipe the brackets for the raising and lowering sprockets, the upper bracket being slotted to allow adjustment for the chain.

(*i*) On the opposite side of the differential housing where the axle housing was cut off, weld a steel dust-protecting disk with a round hole in the center. The hole should be just large enough for the square auger drive shaft to revolve freely.

(*j*) The vertical adjustment lever arm is welded on the propeller shaft housing at a point 3 inches from the differential housing.

(*k*) Reassemble these parts.



Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management*, G. S. Ellsworth; *Chief Counsel*, Clifford E. Fix; *Chief Engineer and Director, Branch of Design and Construction*, Denver, Colo., Walker R. Young; *Acting Chief Information Officer*, Leonard W. Mosby; *Chief Personnel Officer*, Glenn D. Thompson; *Acting Director, Programs and Finance*, Alfred R. Golze; *Director, Branch of Operation and Maintenance*, Goodrich W. Lineweaver; *Director, Branch of Power Utilization*, Harvey F. McPhail; *Director, Branch of Project Planning*, John W. Dixon; *Acting Comptroller*, William F. Kubach; *Director of Supply*, S. W. Crosthwait

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, H. T. Nelson; *Acting Regional Engineer, Branch of Design and Construction*, Grant P. Gordon; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, W. H. Tuller; *Regional Power Manager, Branch of Power Utilization*, Don S. Campbell; *Regional Planning Engineer, Branch of Project Planning*, E. N. Torbert; *Regional Finance Officer, Finance Division*, A. W. Emple; *Regional Information Officer, Information Division*, H. C. Blonk; *Regional Land Officer, Land Acquisition Division*, W. B. Wallace; *Regional Counsel, Legal Division*, H. R. Stinson; *Regional Personnel Officer, Personnel Division*, V. L. Rushfeldt; *Regional Progress Control Officer, Progress Control Division*, R. E. McGowan; *Regional Supply Officer, Supply Division*, James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Anderson Ranch Dam	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Black Canyon Dam	F. E. Hulet	Power superintendent	Emmett, Idaho.
Caldwell	R. W. Adams	Engineer	Caldwell, Idaho.
Cascade	Earl Harmon	Construction engineer	Cascade, Idaho.
Notus	T. E. Nelson	Irrigation manager	Notus, Idaho.
Nyssa	J. E. Spofford	do	Nyssa, Oreg.
Vale	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes	C. H. Spencer	Construction engineer	Bend, Oreg.
Hungry Horse	Paul A. Jones	Project engineer	Columbia Falls, Mont.
Minidoka	S. R. Marean	Superintendent	Burley, Idaho.
Palisades	I. Donald Jerman	Project engineer	Post Office Box 1259, Idaho Falls, Idaho.
Umatilla	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.
Yakima	Olaf Lindgren	Construction engineer	7½ 2d St., Yakima, Wash.
Rathdrum Prairie	Eugene Lavonture	Watermaster	Post Office Box 831, Post Falls Unit, Coeur d'Alene, Idaho.
Project Planning Offices			
Boise (Central Snake River district)	John V. Otter	Engineer	214 Broadway, Boise, Idaho.
Kalispell	C. S. Hazen	do	Post Office Box 97, Kalispell, Mont.
Medford	F. C. Hart	do	Post Office Box 1389, Medford, Oreg.
Salem	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla	M. Boyd Austin	do	Post Office Box 718, WallaWalla, Wash.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director*, R. S. Calland; *Assistant Regional Director*, Phil Dickinson; *Assistant to the Regional Director*, U. J. Gendron; *Regional Engineer, Branch of Design and Construction*, A. R. McGinness; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, J. G. Lindley; *Regional Power Manager, Branch of Power Utilization*, B. W. Crelm; *Regional Planning Engineer, Branch of Project Planning*, S. A. Kerr; *Regional Finance Officer, Finance Division*, J. F. Kastl; *Acting Chief, Land and Right of Way Division*, Joe H. Leech; *Regional Information Officer, Information Division*, Max Stern; *Regional Counsel, Legal Division*, L. O. Graham; *Regional Personnel Officer, Personnel Division*, H. F. Osborne; *Regional Supply Officer, Supply Division*, H. F. Halliday

	Official in charge		Address
	Name	Title	
District Offices			
Delta district	C. H. Kadle, Jr.	District manager	Post Office Box 1407, Sacramento 10, Calif.
Klamath district	Raymond R. Best	do	Post Office Box 312, Klamath Falls, Oreg.
Lower San Joaquin district	J. W. Rodner	do	Post Office Box 1270, Merced, Calif.
Sacramento Valley district	J. K. Carr	do	Post Office Box 302, Chico, Calif.
	C. L. Hudspeth	Engineer	Post Office Box 30, 114 Second St., Colusa, Calif.
	I. C. Harris	Construction engineer	Redding, Calif.
	E. R. Asdell	Superintendent	Orland, Calif.
Tulare Basin district	Robert B. Cozzens	District manager	406 Patterson Bldg., Fresno, Calif.
	Henry Karrer	Field office superintendent	2510 M Street, Bakersfield, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.
	Jeffery Nielsen	Acting field office superintendent	Post Office Box 1372, 1115 Eye St., Modesto, Calif.
	G. C. Imrie	Resident engineer	Tracy, Calif.
	W. A. Alexander	Acting field office superintendent	Post Office Box 1260, E. Acequia and S. Bridge Sts., Visalia, Calif.
Project Planning Offices			
Santa Barbara	J. H. Fertig	Engineer	201 La Arcada Bldg., 1114 State St., Santa Barbara, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer, Branch of Design and Construction*, C. A. Bissell; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, A. B. West; *Regional Power Manager, Branch of Power Utilization*, R. V. Sprague; *Regional Planning Engineer, Branch of Project Planning*, E. G. Nielsen; *Regional Finance Officer, Finance Division*, M. E. Ruhs; *Chief, Land Acquisition Division*, O. J. Littler; *Regional Counsel, Legal Division*, R. J. Conley; *Chief, Office Services Section, Supply Division*, A. G. Risley; *Regional Personnel Officer, Personnel Division*, M. H. Mitchell; *Regional Progress Control Officer, Progress Control Office*, D. A. Dodel; *Chief, Office of River Control*, C. P. Vetter

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
All American Canal (Coachella division).	C. S. Hale	Construction engineer	Coachella, Calif.
Gila (Construction)			Yuma, Ariz.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	P. O. Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	do	Parker Dam, Calif.
Blythe	W. W. Gage	Engineer	Blythe, Calif.
Phoenix	W. E. Sims	do	Phoenix, Ariz.
Phoenix Substation	O. K. Mangum	do	Do.
San Diego	R. E. Burnett	do	Escondido, Calif.
Project Planning Offices			
San Bernardino	F. R. Smith	do	Post Office Box 403, San Bernardino, Calif.
Escondido	R. E. Burnett	do	Post Office Box 357, 414 West 3d St., Escondido, Calif.
Holbrook	R. N. Parnell	do	County Fair Bldg., Post Office Box 606, Holbrook, Ariz.
Overton	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix	V. E. Larson	Assistant regional planning engineer	313 North Third Ave., Security Bldg., Phoenix, Ariz.
St. George	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant to Regional Director*, C. D. Woods; *Regional Engineer, Branch of Design and Construction*, C. H. Carter; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, D. S. Stuver; *Chief, Resources and Development, Branch of Power Utilization*, L. E. Mathews; *Regional Planning Engineer, Branch of Project Planning*, Reid Jerman; *Regional Finance Officer, Finance Division*, F. J. Farrell; *Regional Land Officer, Land Acquisition Division*, N. T. Olson; *Regional Counsel, Legal Division*, J. S. McMaster; *Regional Personnel Officer, Personnel Division*, H. G. Mignon; *Procurement Officer, Supply Division*, E. G. Bywater

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area Planning Offices			
Fallon	W. H. Slattery	Engineer	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Hedderman	Area engineer	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 87, Grand Junction, Colo.
Kemmerer	P. B. Delong	Engineer	Town Hall, Post Office Box 891, Kemmerer, Wyo.
Logan	E. K. Thomas	Area engineer	46 East Center, Post Office 294, Logan, Utah.
Spanish Fork	P. R. Neeley	do	Post Office Box 71, City Hall, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Texas

Acting Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Assistant Regional Engineer, Branch of Design and Construction*, O. L. Crail; *Regional O. & M. Supervisor, Branch of Operation and Maintenance*, R. S. Bristol; *Regional Power Manager, Branch of Power Utilization*, A. H. Sullivan; *Regional Planning Engineer, Branch of Project Planning*, Rex R. Reed; *Assistant Regional Finance Officer, Finance Division*, C. L. Harris; *Regional Counsel, Legal Division*, S. L. Baird; *Regional Personnel Officer, Personnel Division*, H. P. Kirby; *Regional Progress Control Officer, Progress Control Office*, D. R. Burnett; *Regional Safety Engineer, Safety Division*, A. T. Cromwell; *Regional Supply Officer, Supply Division*, I. O. Campbell

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	Wayne S. Byrne	Construction engineer	Altus, Okla.
Balmorhea	W. B. Bierce	Acting construction engineer	Balmorhea, Tex.
Carlsbad	H. H. Kidder	Project superintendent	Carlsbad, N. Mex.
Elephant Butte Power & Storage	R. J. Walter, Jr.	Construction engineer	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Rio Grande	L. R. Flock	Project superintendent	U. S. Courthouse, El Paso, Tex.
San Luis Valley	D. M. Forester	Project engineer	117 Jefferson St., Monte Vista, Colo.
Tucumcari	M. M. Starr	Construction engineer	Tucumcari, N. Mex.
Valley Gravity	H. E. Robbins	Acting project engineer	McAllen, Tex.
Yaleta	F. D. Postle	Division superintendent	Yaleta, Tex.

REGION V—Continued

	Official in charge		Address
	Name	Title	
Project Planning Offices			
Albuquerque	J. L. Mutz	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	L. W. Smith	Acting area planning engineer	Littlefield Bldg., Austin, Tex.
Oklahoma City	M. G. Barclay	Area planning engineer	Post Office Box 495, 316 Key Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Stapleton Building, Post Office Box 2130, Billings, Mont.

Regional Director, Kenneth F. Vernon; *Assistant Regional Director*, W. E. Rawlings; *Assistant to the Regional Director*, George O. Pratt; *Regional Engineer, Branch of Design and Construction*, C. G. Anderson; *Regional O. & M. Superintendent, Branch of Operation and Maintenance*, H. H. Johnson; *Regional Power Manager, Branch of Power Utilization*, J. R. Walker; *Regional Planning Engineer, Branch of Project Planning*, C. T. Judah; *Regional Finance Officer, Finance Division*, Duncan Mills; *Regional Land Officer, Land Acquisition Division*, W. N. McCormick; *Regional Counsel, Legal Division*, W. J. Burke; *Temporary Chairman, Interior, Missouri Basin Field Committee*, William G. Sloan; *Chief, Reports Staff, Missouri Basin Reports*, Mills E. Bunger; *Regional Personnel Officer, Personnel Division*, Alfred W. Gaede; *Progress Control Officer, Progress Control Division*, Don H. Huff; *Regional Supply Officer, Supply Division*, Fred W. Gilbert.

	Official in charge		Address
	Name	Title	
Project Offices			
Angostura unit	H. V. Hubbell	Project engineer	Evans Hotel, Annex Bldg., Post Office Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Federal Bldg., Newell, S. Dak.
Missoula Valley	C. R. Wipple	Construction engineer	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Boysen & Owl Creek units	R. S. Lieurance	Project engineer	Post Office Box 1111, Thermopolis, Wyo.
Buffalo Rapids	J. W. Grimes	Construction engineer	Masonic Temple Bldg., Terry, Mont.
Fort Peck	Allen Mattison	Resident engineer	Post Office Box 1245, Fort Peck, Mont.
Intake	J. W. Grimes	Construction engineer	Masonic Temple Bldg., Terry, Mont.
Milk River	H. W. Genger	Superintendent	Malta, Mont.
Rapid Valley	H. V. Hubbell	Project engineer	Evans Hotel Annex Bldg., Post Office Box 812, Hot Springs, S. Dak.
Riverton	D. L. Carmody	do	Post Office Bldg., Riverton, Wyo.
Shoshone	W. F. Kemp	Acting project engineer	Post Office Box 900, Cody, Wyo.
Sun River	C. L. Bailey	Superintendent	Federal Bldg., Fairfield, Mont.
Area Planning Offices			
Billings	Carl L. Myers	Engineer	Post Office Box 1264, Billings, Mont.
Bismarck	Bruce Johnson	do	Post Office Box 328, First National Bank Bldg., Bismarck, N. Dak.
Pierre	W. W. Baker	do	Hyde Bldg., Post Office Box 122, Pierre, S. Dak.
Wolf Point	H. W. Mutch	Acting project engineer	Court House, Post Office Box 971, Wolf Point, Mont.
Great Falls	T. R. Smith	Engineer	1015 1st Ave., N., Post Office Box 1729, Great Falls, Mont.

REGION VII: Headquarters, 501 Continental Oil Building, Denver, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director*, W. E. Blomgren; *Acting Regional Engineer, Branch of Design and Construction*, Herbert E. Prater; *O. & M. Supervisor, Branch of Operation and Maintenance*, John N. Spencer; *Power Manager, Branch of Power Utilization*, Harold R. Lee; *Planning Engineer, Branch of Project Planning*, John H. Keimig; *Finance Officer, Finance Division*, Carl M. Voyen; *Land Officer, Land Acquisition Division*, Mark W. Radcliffe; *Regional Counsel, Legal Division*, Clarence Eynon; *Personnel Officer, Personnel Division*, Albert R. Novak; *Supply Officer, Supply Division*, William F. Shs.

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Guernsey	W. S. Francescato	Clerk	Guernsey, Wyo.
Kortes	C. S. Rippon	Construction engineer	Casper, Wyo.
Seminoe Dam	E. T. Walters	General foreman	Seminoe Dam, Wyo.
Colorado-Big Thompson	C. H. Howell	Project engineer	Estes Park, Colo.
Fort Morgan	G. W. Hall	Foreman	Fort Morgan, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Horsetooth Reservoir	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	Matt C. Bowman	Engineer	Loveland, Colo.
Republican River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Enders Dam	U. V. Engstrom	Construction engineer	Imperial, Nebr.
Ainsworth (Niobrara Basin)	C. E. Burdick	Engineer	Ainsworth, Nebr.
Casper (North Platte Basin)	I. J. Matthews	District manager	Casper, Wyo.
Cheyenne (South Pass diversion and Yampa-North Platte diversion project).	E. H. George	Engineer	Box 658, Cheyenne, Wyo.
Denver (Blue-South Platte)	J. H. Knights	do	331 United States National Bank Bldg., Denver, Colo.
Grand Island (Platte River Investigations).	P. L. Harley	do	Grand Island, Nebr.
Pueblo (Gunnison-Arkansas and Upper Arkansas River Basin).	B. F. Powell	Engineer	Box 515, Pueblo, Colo.
Topeka (Kansas River investigations)	W. C. Brady	do	505 New England Bldg., Topeka, Kans.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont.	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lemont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	Superintendent.	Louie Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hilbel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr.	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	William T. Davis	Brigham City, Utah
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompsen	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J Bracken Lee	Price, Utah
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Denver irrigation district	Denver, Wyo	Robert W. Fifield	do	William P. Peebler	Denver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Al Hiat	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D R Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A C Houghton	do	A C Houghton	Irrigon, Oreg
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D D Harris	do	D. D Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J D Corliss	do	J D Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	O L Sterling	do	O L Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

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2. Secure a 1-inch square shaft 65 inches long and mount it in a lathe. Turn down in the lathe 2 inches of one end to a diameter of 1 inch. This end also is drilled and tapped for a ½-inch cap screw.

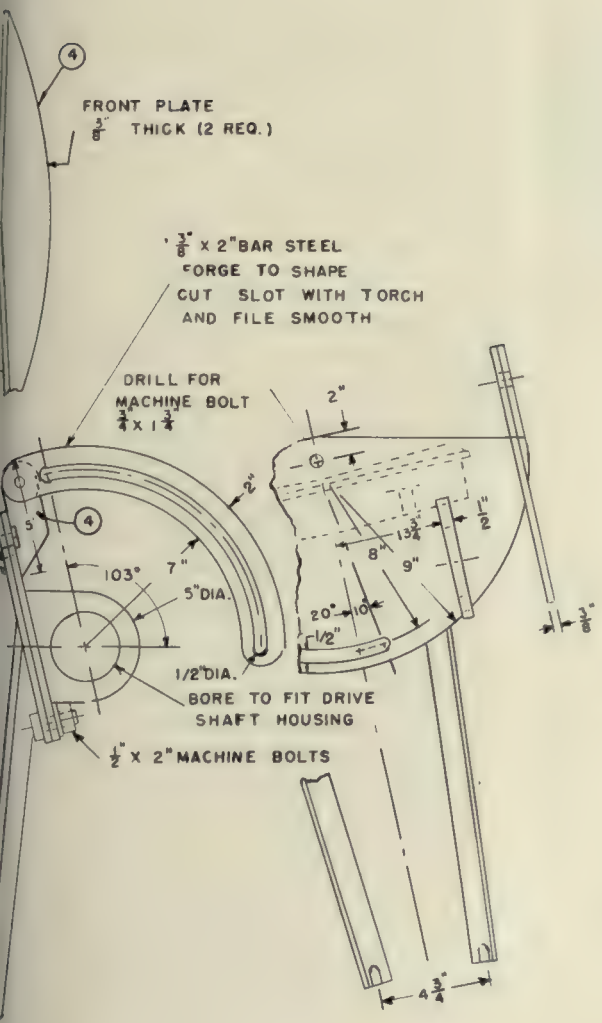
3. Make a round steel bearing 1¾ inches long that will slide through the 2-inch pipe (see No. 1 (*g*), with a bore that will make a running fit on the turned end of the square shaft. The bore should be bushed with bronze. To the side of this bearing weld the bracket that will later be bolted to the raising and lowering chain. Make a steel thrust washer 2 inches in diameter and ¼ inch thick with a 1-inch bore and place it on the turned end of the square shaft. Weld to square shaft. Make another steel washer 2 inches in diameter and ¼-inch thick with a ½-inch bore. Assemble bearing on end of square shaft. Hold in place with a ½-inch cap screw and steel washer. Bore two ⅜-inch holes in opposite end of square shaft for attaching auger.

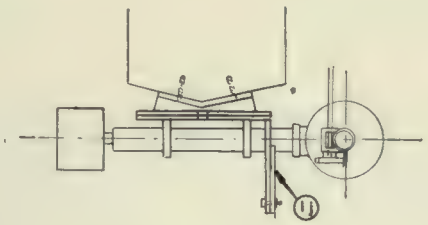
4. Cut two steel plates as shown for mounting on tractor. To the back plate weld angle-iron brackets and braces for attaching to tractor. Brackets and braces shown are for attaching to John Deere Model A. Adaptations can be made for other tractors. On front place weld brackets for holding attachment and vertical adjustment bracket.

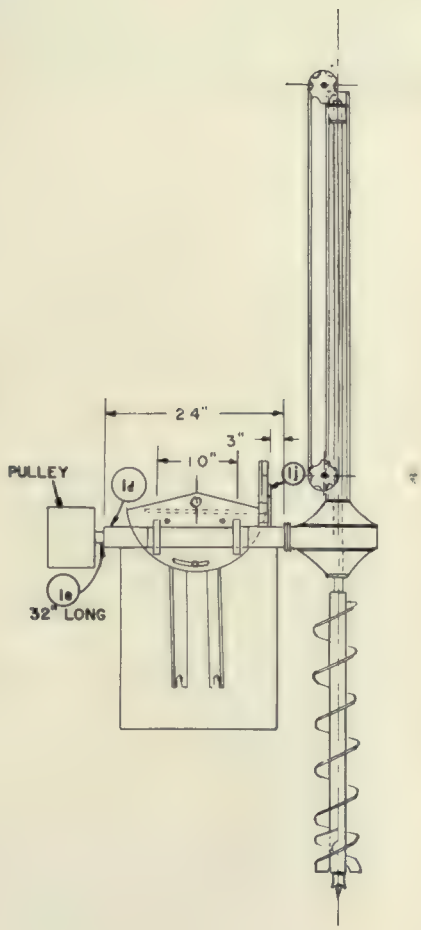
5. Make angle-iron bracket that bolts to rear axle of tractor for carrying, raising, and lowering wheel.

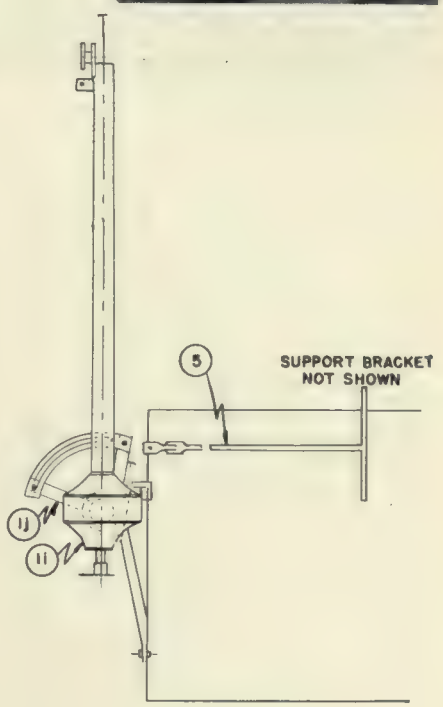
6. Raising and lowering shaft connects to the lower sprocket shaft through a universal joint by means of a bolt at the forward end and a loose-pipe bearing at the handwheel end, bearing being fastened to angle-iron bracket (see No. 5).

7. The auger can be made, purchased, or a grain auger used. It should be approximately 8 inches in diameter and 30 inches long. To upper end of auger shaft, weld a square tube 1-inch by 1-inch inside measurements and 6 inches long. Drill ⅜-inch holes in this square end to match holes in end of square drive shaft. Machine bolts are used for attaching the shaft to the auger. Auger cutting lips should be hard-surfaced to limit excessive wear. The drive pulley should be about 10 inches in diameter and 4 inches wide, with a bore to fit the drive shaft.









Drawing and photograph courtesy of the Extension Service, Colorado A. & M. College, Fort Collins, Colo.

Never Underestimate a Bee

(Continued from page 197)

colonies pollinating orchards, has good reason to realize the value of beekeeping. Mr. H. A. Hill, agricultural aid for the Sacramento Valley District, points out that honeybees were war workers, putting the value of pollinating foremost, as evidenced by the fact that during the war years no restrictions were placed on the manufacture of apiary supplies to take care of bees that were used to increase pollination. This was not the case where honey and wax were the main concern.

Region III states unequivocally that bees greatly aid in the pollination of alfalfa bloom for seed production.

Although pressure of business did not permit Region IV to reply to Mr. Hambleton's question in time for this issue, this year's Utah centennial has called attention to the fact that the Mormons chose the name of *Deseret* for their provisional State while awaiting congressional action giving them territorial government. Deseret means "honeybee," and symbolizes thrift and industry. Obviously, this aid to agriculture has been and is appreciated in the Great Salt Lake region.

Region V's Rio Grande project personnel report that in those areas of the project where alfalfa is permitted to seed, farmers "borrow" from apiaries one stand of bees for each acre in alfalfa seed. Bees are also used in onion seed pollination.

In the San Luis Valley, one of the largest honey-producing areas in the State of Colorado, project engineer D. M. Forester says, "The local beekeepers all fully realize the necessity and value of the use of bees in pollination of fruit and clover crops. Most of them place the value of honey secondary to the value of crop pollination."

And from the project engineer of the Valley Gravity project came a mass of material indicating the interest of Texans in the migratory bee business, and the value of honeybees for increasing productivity in the citrus groves.

The Regional Director of Region VI says that the Yellowstone Basin produces a great deal of honey due to the prevalence of sweet clover.

The Regional Director of Region VII, with his graphic story of the Red Clover crop and his information on other projects in the region where beekeeping is practiced, also says, "In irrigated areas where farm produce is quickly converted by nearby canning factories into processed foods, honeybees are coming into their own. Cucumber growers, anxious to receive top prices for prime cucumber pickles, hire the services of a beekeeper to reduce the number of nubbins, crooked and otherwise undeveloped cucumbers caused from inadequate pollination by honeybees. Other crops in the Rocky Mountain area depend as well on pollination by bees. To produce a profitable alfalfa seed crop it is essential to have an abundance of insect pollinators. Similarly, insects must transport the pollen from one plant or tree to another to produce a profitable cherry, apple, or pear crop. Actually bees produce much more cash income for the alfalfa seed grower and orchardist than is procured from the yield in honey and beeswax, harvested by the beekeeper."

He concludes that, "It is not unlikely that seed growers of the future will either own their honeybees or rent them from a beekeeper for use in tripping and cross-pollinating their alfalfa such as fruit growers now do. Cross-pollination not only results in a more abundant seed set, but also in more vigorous seeds.

"Growth of the bee industry in Colorado is indicated by the legislation approved by the recent session of the general assembly, under which the State may guard against the spread of American or European foulbrood. It also prohibits the sale or movement of bee colonies, nuclei or used equipment that is diseased and makes compulsory certificates of inspection. With the influx of 'migrant bee labor' from other States, the amendments added by the legislature to present laws provide for inspection of bees and the issuance of permits. Further protection to the industry is provided by an amendment making it unlawful to spray or dust with any poisonous material injurious to bees any agricultural crops or fruit trees which are attractive to bees while in bloom," he added.

According to the Department of Agriculture, most of the States now have legislation on their books requiring inspection of bees and bee equipment.

Diseases of Bees

In addition to stringent legislation to control such diseases as American and European foulbrood, caused by bacterium which attack the bee larvae, other measures are taken by farmers in the reclamation area.

Charles Williams of Meridan, Idaho, states that he has had good luck with the use of sulfathiazole to counteract foulbrood. He feeds it to the bees in a solution of sugar sirup or sugar and water. Colonies which were infected appear to be clean, William said.

In the Sacramento Valley District of Region II, some experimental work has been done with sulfathiazole to combat American foulbrood. In the past the average loss has been around 2 percent from this disease. The majority of the keepers prefer to burn the diseased colony and eliminate any possibility of the bacteria being present in the honey.

Despite encouraging results in other places from the use of sulfathiazole, some Rocky Mountain area beekeepers are reluctant to use it to combat foulbrood. Some entomologists claim the drug prevents the spread of the disease but fails to cure it.

The project engineer of the San Luis Valley project, with headquarters at Monte Vista, Colo., states that sulfa drugs are used quite extensively by most of the beekeepers in that area and are considered a very good cure for American foulbrood. Many drugs and experiments have been tried in order to find a cure for European foulbrood, but so far nothing has been found in that locality to combat it.

Mr. E. B. Ault of Weslaco, Tex., president of the Valley Bee Association, attacks the problem of foulbrood more fundamentally. He breeds three races of bees, the Italian, Caucasian, and a resistant stock which is mixed with several races, but more of the Italians than any other and is presumed to be more resistant to foulbrood than the other races.

Although the project engineer on the Valley Gravity project, headquarters at McAllen, Tex., reports that foulbrood is not prevalent in the valley, he says precautionary measures are taken. Bees are fed one-half gram of sulphathiazole to a gallon of sirup during the spring months.

Poisonous Sprays

More destructive than foulbrood or other diseases to which bees are susceptible are the insect and weed-control measures put into effect by progressive, successful reclamation farmers.

"Dusting" crops precipitated a small drama in the Boise Valley of Idaho. One beekeeper threatened to move his bees to Montana because of the danger of poisoning if seed-growing farmers in Canyon County insisted on dusting their crops. The farmers disregarded the threat and proceeded with their dusting. The beekeeper accordingly transported his colonies elsewhere. During the subsequent harvest the farmers found that their yield had been tremendously reduced, and since then bees have been made welcome in the Boise Valley. Last year a group of farmers came from northern Idaho offering to pay transportation and a rental charge of $2 per colony (which appears to be the prevailing rate) if the Boise Valley beekeepers would move bees into their area to pollenize their white Dutch and Alsike clover. Farmers in the Emmett Valley of Idaho, near the Boise area, also rent bees for pollenizing the cherry orchards.

Beemen, orchardists, and dusting airplane operators in the Yakima Valley have worked out cooperative agreements so that not many of the bees are lost annually because of the drift of insecticides carrying poison sprays or poisonous dust.

Arsenic Poisoning

The Yuma project in Region III reports a decrease in value of the bee population from more than $27,000 in 1945 to about $16,000 in 1946, due principally to the number of bees which were killed by arsenical vegetable dusting. Cooperative agreements between the vegetable growers and the beekeepers resulted in agreements

(Continued on page 205)

TOO MUCH WATER

ON A CLEAR DAY the Texas Gulf Coastal Plains sparkle like gems as the sun's rays strike velvety, moss-embroidered bayous, quagmires of the region's rice fields, innumerable lakes, and then bounce skyward.

The vast area, virtually as flat as the storied pancake, extends westward 300 miles from the Louisiana border to Corpus Christi. It sweeps inland from the coast on an average of 70 miles, and the land is saturated, like a submerged sponge. There is too much water; a Gargantuan irrigation project without drainage.

Here is a diabolical problem. While too much water remains on the land to permit full cultivation and maximum yields on millions of acres of staple crops and pastures, the area's rice farms, which yield the second largest amount of this grain in the United States, require a great deal of moisture. But even rice lands, without adequate drainage, also suffer from unwanted water at planting and harvest time. The result is a perplexing problem of drainage, coupled with a need for improved, dependable irrigation facilities for rice and perhaps some speciality crops.

The Bureau of Reclamation, now making investigations in the region, estimates that 11 million acres of Gulf Coastal lands may be subject to reclamation. Of this total only slightly more than 2 million acres were under organized drainage works in 1939, according to the 1940 census. However, less than 400,000 acres of the total area under organized drainage works were reportedly cultivated in 1939. The census also indicates that only 1,441,341 acres of the total area were drained sufficiently to produce normal crops.

This subtropical area receives an annual average rainfall of about 45 inches, but there are years when 100 inches drench the country. Rainfall measuring from four to eight inches within a period of 24 hours is not uncommon. A record was established in 1946 at Beaumont, in Jefferson County, when one Gulf storm released 17 inches of unwelcome moisture.

Much of the area that is too wet for cultivation is devoted to livestock grazing, but even pasture lands suffer from excessive moisture. Farmers and ranchers lose enormous sums annually because there is a lack of efficient drainage. The result is a lessening of soil productivity, floods, siltation, and human erosion.

The area is plagued with water-borne diseases, including typhoid, dysentery, and malaria. Industrial concerns often find it difficult to locate building sites in parts of the region. Some have been compelled to drain and fill large areas to gain firm foundations for plant construction. Frequent floods and overflows damage highways, bridges, culverts, and road ballast. A sudden downpour, or a prolonged rainfall, leaves some highways hazardous, others closed against traffic.

Photo by Dale Hovey, Region V

Flooded rice field near Houston, Tex. Levee break in foreground is method used to drain rice lands

The problem of inadequate drainage is not new. The grandfathers of today's modern farmers and ranchers, who lived in the area 100 years ago, suffered also. They knew, as do present day residents in the area, that a lack of drainage affected their soil, crops, livestock, health, and pocketbooks. The Plains were settled by colonists in the early 1800's. A majority of the original settlers were planters from the Deep South, and they turned to growing cotton and sugarcane. The soil was fertile, and the yields were plentiful. New Orleans was a profitable market.

Chenango plantation, 3 miles north of Anchor, a station on the Columbia Tap Railroad in Brazoria County, is symbolic of the area's history and the planters' losing fight against drowning soil. Chenango was founded by Monroe Edwards and a merchant in New Orleans long before the War Between the States. Negro slaves, arrived from Africa, were purchased in Cuba. Slave labor constructed a sugar mill on the plantation, and toiled in the cane fields. Recognizing the need for draining the lands of excess water, the plantation owners set their slaves to digging outlets to nearby streams. Remnants of these crudely engineered and constructed drains, now nourishing large trees and subtropical plant life, are still in evidence. The ivy-covered walls of the old sugar mill, and the bell that summoned slaves to work at sunrise, are all that remain of the old plantation system, if one fails to take into account the problem of inadequate drainage.

After the War Between the States, the production of sugarcane slowly gave way to cotton culture. Former slaves and their children were classified in three groups. Prices for labor ranged from 40 to 75 cents a day. But Chenango, and other plantations in the area, fell victim to the seeping paralysis of insufficient drainage. From those days to the present time, Chenango has passed through numerous ownerships. Each succeeding owner experienced greater difficulty in producing crops than had his predecessor. By 1930, Chenango was lying idle.

The Chenango Experiment

For the past 12 years Chenango has been owned by one man—Brig. Gen. R. C. Kuldell of Houston who purchased the plantation in 1935, a West Point graduate with 15 years' service in the United States Corps of Engineers. He remembers his first trip to Chenango.

> I had to mount a horse to see over the weeds. I was told, and I believed my informant, that it was an abnormally wet year. I soon learned, however, that a lack of drainage was the basic cause for the plantation having been abandoned.

At first, the trained and experienced engineer did not immediately give attention to the installation of drains. Instead, he purchased a supply of agricultural books and accumulated a library of extension bulletins concerned with the breeding and growing of poultry, livestock, and row crops. During his initial fling with nature, he took a terrific beating. But it was the land's failure to produce that brought the engineering training to the fore. When General Kuldell returned to his plantation in 1946 after serving in the armed forces in World War II, he marketed most of his livestock, purchased an engineering level, and began laying out a drainage system on the plantation. After he had constructed his drains, he seeded the fields to pasture, purchased beef-type cattle, and stood by to see what happened.

This year, General Kuldell is grazing 500 head of cattle on the Chenango plantation. The soil that had been exhausted in the struggle to grow cotton on watersoaked land is producing pasture grasses in abundance. In one pasture, 75 head of Brahmans were wintered on 50 acres of grass, where formerly seven to 10 acres were required for grazing one animal. Supplemental, concentrated feed left them in the bloom of butcher cattle.

General Kuldell is more fortunate than most farmers. His training as an engineer enabled him to design and construct effective on-the-farm drains. Even more important, he has a large wooded area in the lower edge of Chenango into which he turns the excess water from his pastures. Were it not for owning a low-lying area to receive waste water, General Kuldell would face a problem that would prove insurmountable for a majority of individuals. He could not have drained his land without damaging the lands of a neighbor.

The crux of the Plains problem is draining on-the-farm water into major outlets which in turn drain it into the Gulf of Mexico without damaging the lands of in-between property owners.

"We have all recognized that drainage is the chief agricultural problem in the Gulf Coastal Plains," said General Kuldell, "but the problem has appeared to be so big that little progress has been made in the over-all solution."

As an engineer, General Kuldell also recognizes and calls attention to the need for **maintaining** drainage systems after they are constructed. The Gulf Coastal Plains are carved with drainage experiments that failed largely because no provision had been made to keep them sufficiently clear of plant growth and sedimentation to allow free passage of water.

Practically all attempts to date to construct adequate drainage outlets in the region have been on a district rather than a watershed basis. Even in the comparatively few successfully drained districts, there are numerous instances where lands on the Gulf coast side of the districts were damaged by waters drained from the areas above them. Many drainage districts have witnessed the deterioration of costly works because there was no provision for maintenance. The drainage works fell prey to Nature's eternal effort to heal man-made scars in the earth.

Drainage Demonstration

Further evidence of the economic worth of drainage in the area has been uncovered by Texas A. & M. College on its experiment station at Angleton. Research men set up seven pastures; ranging from one with native grass, and which received no drainage, conservation or soil building treatment, to others that were properly drained, plowed, disked, seeded, and fertilized. Cash expenditures on pasture No. 7, including cost for applying phosphoric acid, amounted to $16.44 per acre.

Eighty-four head of beef-type heifer calves were divided into groups, and turned into the different pastures in October 1944. At the end of the experiment in May 1946, there were 2,500 more pounds of cattle weight in pasture No. 7 than in pasture No. 1. While gaining an average of 114 pounds more than those on native range, they consumed only $15 worth of feed, compared with $35 worth of feed for those on native pasture. Important also was the fact that cows on the improved pastures produced heavier calves.

Possibly, without exception, each of approximately 21 counties in the Gulf Coastal Plains has its reminders of successive eras in which settlers established homes on the land, farmed a few years, became impoverished, and moved away. From the days of the planter and his slave-operated holdings, the years have been marked by the trek of colonists, who believed they had the skills and the courage needed to overcome the fundamental problems. Mennonites established communities in various sections of the region; Czechs and Bohemians, farmers from Iowa, Illinois, Missouri, Kansas, were brought into the area by promotional schemes. A great many settlers, some with considerable wealth, built substantial homes and farm buildings, but their inherent systems of farming and attempts to raise northern grains resulted in failure. Of all the settlers in the area, the Germans and Poles appeared to be the most successful, and their descendants are among the leading, prosperous farmers in the area at the present time.

Early day ranchers apparently fared better than the farmers, and in recent years some ranch lands have been devoted to rice production, although beef cattle production still is an important industry. Rice and cattle grazing follow a pattern of rotation. From 1 to 2 years following a rice crop, rice farmers graze livestock on the idle land. This system has been successful, but the maximum income from either source cannot be achieved until facilities are made available for efficient drainage.

Good surface drainage is as necessary for successful rice culture as is a dependable supply of fresh irrigation water. Without useful drainage it is difficult to prepare satisfactory seedbeds, to obtain good stands, to produce and harvest satisfactory crops; for, unless fields are drained quickly and sufficiently to support tractors and binders, the grain shatters, and much of it is lost in the soil.

Recent years have witnessed an increased effort to achieve drainage for the Plains country. Drainage districts have been created, organizations of farmers have joined with chambers of commerce in attempts to find a solution to the problem; but, as noted by General Kuldell, the problem is so big that little progress has been made in the over-all solution. Rice growers, cotton farmers, ranchers, and other property owners believe that their lands would double present yields and that the quality of their products would improve greatly if a way could be found to get rid of excess water.

Complete relief, however, depends upon a closely integrated plan for drainage systems in each of the various watersheds in the region. There is urgent need for a comprehensive study of the problem by the people in the Gulf Coastal Plains and the several agencies of Government, including the United States Corps of Engineers, the Bureau of Reclamation, and the Department of Agriculture, all of whom have special skills with which they may serve the property owners.

Landowners, farmers, businessmen, and community leaders are intensely interested in the Bureau's present surveys in the Coastal Plains region, which are expected to be completed this fall. From these studies and from the drawing boards of the skilled engineers, soils technicians, economists, and other specialists will come the basis of a pattern that could result in the reclamation of millions of acres.

Sometime, perhaps in the not distant future, the people, assisted by their agencies of government (local, State, and Federal), will roll up their sleeves and dig drainage outlets to the sea. When that time comes, it will be a national achievement; it could easily become the signal for the beginning of a program to reclaim millions of acres of wet lands in other States.

There are 75 million acres of unreclaimed swamp and overflow lands in the humid and subhumid areas of the Nation which, according to some agricultural economists, possess even greater agricultural potentialities than western arid lands.

Conditions now cramping and stifling human life could be removed if people calculate the amount of prosperity that could result from reclamation, rather than how much reclamation costs.

If proof were necessary, it could be provided in the river basins of the West, where reclamation has transformed millions of acres of wasteland into areas of maximum usefulness.

RIVER-SIZE CANAL

Speed and skill mark the excavation of the main canal of the Columbia Basin project in Washington

by Wafford Conrad,
Region I, Coulee Dam, Wash.

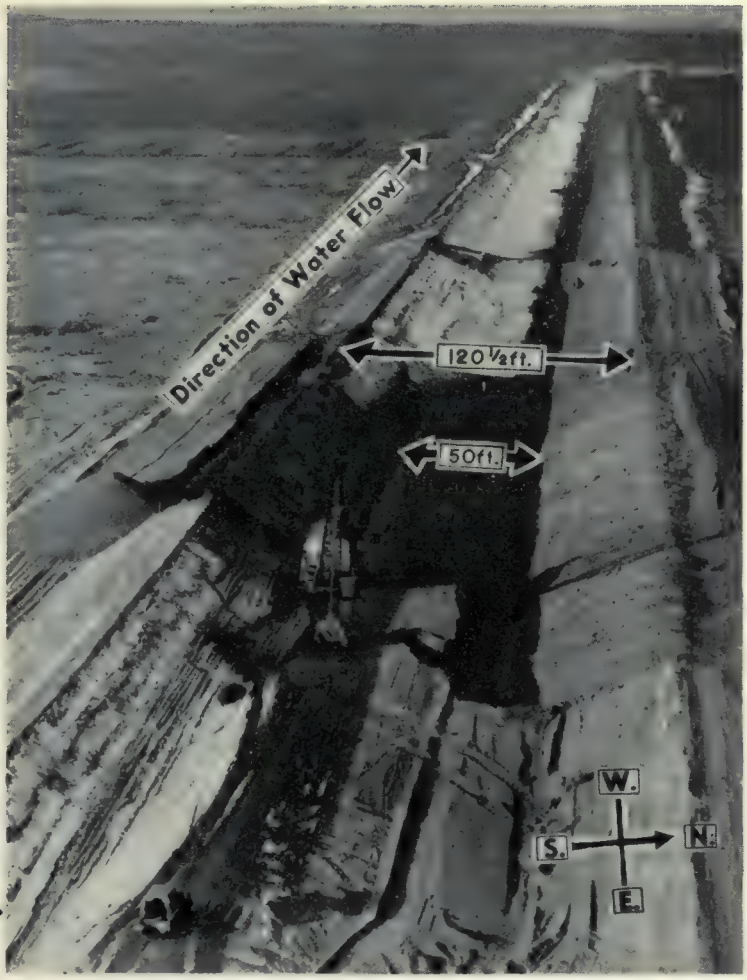


Photo courtesy Seattle Post-Intelligencer, Seattle, Wash.

At right, aerial view of Columbia Basin project's main canal. Walking dragline is dwarfed by size of excavation.

From our distant vantage point, the canal looked like some gigantic prehistoric serpent twisting its way across the plain.

Coming nearer, we could see only a high embankment that for the most part followed along the base of a low range of sagebrush-dotted hills. Our guide, Philip M. Noble, Columbia Basin project resident engineer for the construction job, drove out upon a light steel bridge spanning the canal, and stopped.

"This is an army Bailey Bridge," he said. "War surplus. Several of them are being used to carry county roads over the canal until permanent bridges can be built." We climbed out of the car and peered over the bridge railing.

It was like looking into a deserted city street from the top of a three-story building.

The two railroad men from St. Paul, the school teacher from Chicago, and the war veteran from Seattle expressed surprise at the size of the canal. It was much bigger than they had imagined.

"A good-sized stream would only wet the bottom," one of the railroad men commented.

Engineer Noble pointed out that the canal could carry the combined average flows of several medium-sized rivers. It was 120½ feet wide at the top, 50 feet wide at the bottom, and 23½ feet deep. Irrigation water some day would flow nearly 21 feet deep down the canal.

Our eyes followed along the smooth, sandy floor of the canal and up its sloping sides to what appeared to be shelves near the tops of the banks.

"What are those?" asked the school teacher.

"Berms", Noble answered.

"And what are berms?"

"They are benches along sloping embankments, made to accommodate a path or road," he explained. "The berms you see here will carry rails upon which trimming and paving machines will ride. One machine will trim the canal to its final shape; the other will apply a lining of concrete. This work will be done under a contract yet to be awarded.

"Small draglines and trucks also can operate on the berms. After the canal is lined, the berms will be filled in with earth to the level of the tops of the main banks. This will give the banks extra stability.

"But where the canal is built along a hillside, and this is done whenever possible, only the berm on the downhill side of the canal will be filled in. The hillside bank will be stable enough. The top of the downhill bank will be 28 feet wide, and will provide a permanent roadway for ditchriders."

As the engineer talked, the job of building an irrigation canal loomed bigger and bigger. There was a lot more to it than digging a ditch and piling the excavated material along the sides.

First of all, the canal route must be determined by surveys, and by tests of the materials that will have to be excavated. Then rights-of-way must be obtained, designs and specifications prepared, bids called, contracts awarded, and the work staked out for the successful contractor. On Bureau of Reclamation projects, these preliminaries are done by the Government.

This particular canal job marked the start of construction on the distribution system for the million-acre Columbia Basin project—the largest single irrigation enterprise this Nation has undertaken. And it was the first contract completed.

The Morrison-Knudsen Co. of Boise, Idaho, had underbid 15 competitors, offering to build the 6.6-mile southern section of the Main Canal for $619,000. This section would run from the site of Long Lake Dam, near Stratford, Grant County, Wash., westward to its terminus, about halfway to Soap Lake, a health resort town. Bureau engineers had estimated the job would require excavating more than 2,000,000 cubic yards of earth and rock, and the building of about 500,000 cubic yards of

compacted embankments. A 4½-inch concrete lining, and other canal structures, would be covered in a later contract.

The Boise contracting firm, which holds construction contracts around the world, did not let any sagebrush grow under its feet. Weeks before the Bureau's official notice to proceed was issued in June 1946, M-K officials had successfully overcome initial problems such as the shortage of building materials and housing.

Company workmen, including a number of ex-GI's, bulldozed access roads out of the volcanic ash soil which sent up choking clouds of dust when disturbed. They laid more than 2 miles of 4-inch pipe to bring water to the job from the nearest source of supply—a farmer's well. They cleared the canal right-of-way by grubbing up the sagebrush that thrives even in this semiarid area. They drilled holes in rocky portions of the right-of-way, and blasted the hard basalt to pieces. They ploughed the ground surfaces on which the canal embankments would be built up.

Most of the excavation work was done by a huge Bucyrus-Monighan walking dragline which the contractor had first used in constructing a Mississippi River levee, and had shipped to the eastern Washington job from a Nebraska project. Engineer Noble described it something like this:

The Monighan scoops up dirt with a steel-toothed bucket suspended on cables from the end of a 110-foot boom, or arm, like ordinary draglines. But instead of being mounted on caterpillar treads, the Monighan sits firmly on its circular base when working, and walks by raising and lowering pontoon-like feet suspended from big revolving cams in its sides.

Like that storied bird which flies backwards because it doesn't care where it's going—just where it has been, the Monighan waddles backward along the center of the right-of-way. It tosses earth right and left as it goes, leaving a canal behind it.

Where the earth along the right-of-way was suitable for compacting into canal embankments, the Monighan was preceded by sprinkling trucks, and tractor-pulled carry-alls and sheepsfoot rollers. The soil was sprinkled to give it the correct moisture content for compacting. Bureau men tested samples frequently. Then carry-alls scraped up the damp soil and deposited it in 6-inch layers for the inner core banks. The rollers, with their scores of hoof-like appendages, compacted each layer of earth. The Monighan completed the excavation, dumping the excavated material to form an outer main bank of loose earth or rock.

This two-section bank construction was used the entire length of the canal on its downhill side, and for both sides where the canal was not built along a hillside. The inner core bank was necessary to provide a stable foundation for the concrete lining wherever it was to be placed on filled material above the natural ground surface. This was unnecessary where a cut in a hillside formed one bank.

On-the-site supplies for constructing the compacted embankments were not always available. Most of the material encountered consisted of sand and gravel overlain with one to three feet of fine soil, which made ideal core banks when moistened sufficiently. Approximately 1 mile of the excavation was almost wholly in fine, sandy loam. But scattered deposits of pumice and some tough basalt were entirely unsuitable.

The pumice discoveries, however, aroused considerable local interest. Building blocks made of pumice had proved popular in some areas of the Pacific Northwest, and some businessmen envisioned a new industry for the region. But the excitement was short-lived. Investigations indicated the deposits were not suitable for commercial use.

A half mile of the canal was located along the foot of a lava cliff. Weathered rock, which had fallen from the cliff, covered the right-of-way. This loose rock and the underlying bedrock were used in constructing the outer bank of the downhill side of the canal, and in filling an excavation made outside and just below the right-of-way to obtain material for building up the core bank. Silty loam was dug from this "side borrow" pit by a small dragline and cast onto the core bank, where it was spread with a bulldozer and rolled with a sheepsfoot roller.

When this source of material was exhausted, the shovel was moved to a "borrow pit" several hundred yards from the canal. Earth excavated from this pit was hauled to the core bank in trucks.

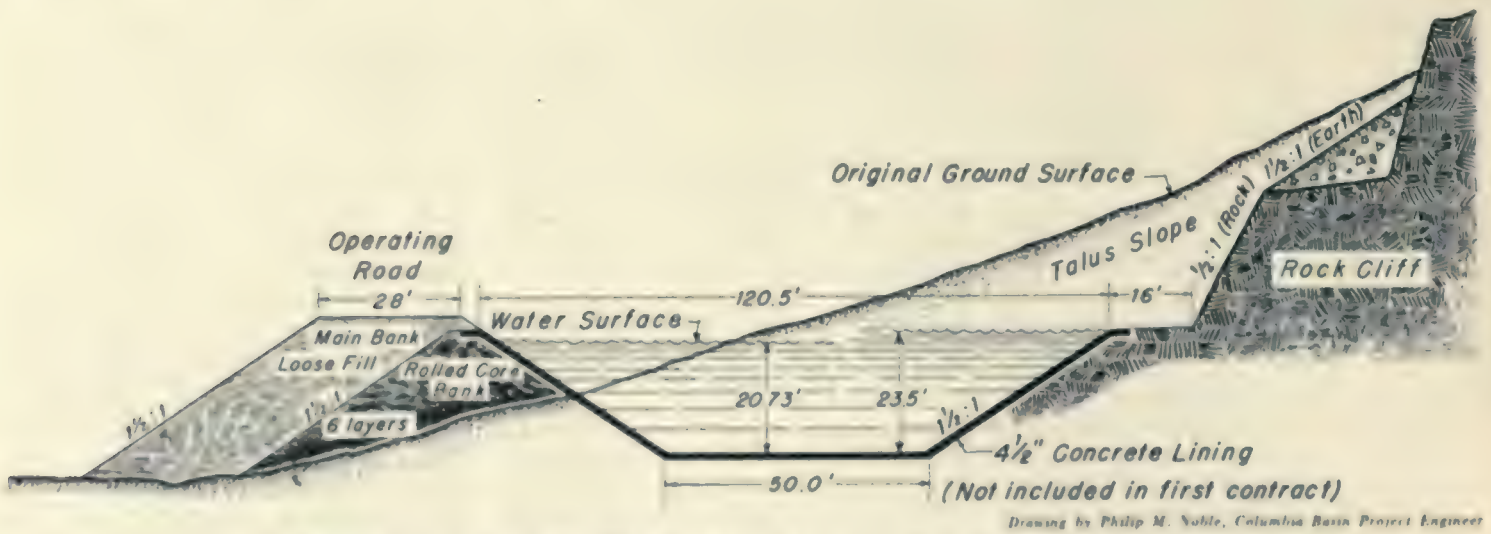
Noble explained that Bureau designing engineers try to lay out irrigation canals so that the contractor can obtain sufficient earth and rock from the excavation to build up the core banks and main banks. Borrowing the material outside the canal right-of-way is slower and more expensive.

Big as it looked, this southern portion of the Main Canal will be dwarfed by the northern section, and by the Feeder Canal which will carry water from the Grand Coulee Dam pumping plant on the Columbia River to a 27-mile reservoir that will feed the Main Canal. The Feeder Canal will carry 16,000 cubic feet per second, the northern section of the Main Canal 13,200, and this section 9,700.

"How much water is 9,700 cubic feet per second?" the school teacher asked.

"Well," replied the Bureau of Reclamation engineer, starting the car, "it's more than 70,000 gallons per second—enough to irrigate 800,000 acres of the million-acre Columbia Basin project, or to supply the normal domestic water needs of about 35,000,000 people."

"Whew!" said the veteran, "some ditch!"



Drawing by Philip M. Noble, Columbia Basin Project Engineer

Typical cross section of the Main Canal from Long Lake Dam to East Low Turnout.

and regulations which now presumably prevent the use of arsenical insecticides in areas where beekeeping is practiced.

The chief drawback to bee culture on the Rio Grande project in Texas is the arsenicals which are used to dust cotton plants in late summer and fall for cotton-leafworm control. Hive mortality is often 100 percent from arsenic poisoning, it is reported. During the period of cotton dusting, the bee not only comes in direct contact with the arsenic preparation, but also feeds the hive brood with the poisoned honey dew. During the season of cotton dusting, bee hives are usually moved out to the mesas away from the cotton fields in an effort to prevent poisoning.

From the Valley Gravity project comes the same complaint—valley beekeepers lost a large number of colonies of bees last fall due to the calcium arsenate used in dusting crops to kill insects. This project reported that DDT and sulphur also used in dusting crops and trees did not appear to be harmful to bees.

Mr. C. F. Webster, of the Yakima project, reports that beekeepers bring the hives into the orchards just before blooming-time and remove them as soon as the farmer is ready to apply the calyx spray, to avoid poisoning the bees.

Agricultural aid H. A. Hill of the Sacramento Valley District forwarded a hopeful note from the May 1947 volume of *Gleanings in Bee Culture* which stated: "It would seem unnecessary to continue the use of calcium arsenate or other arsenicals for the control of insect pests on tomatoes, deciduous fruits, and most field crops when DDT will give better control and be less toxic to bees, domestic animals, and to man."

Migratory Bees

A "bee-line" is usually understood to mean the shortest distance between two points and Charles Williams of Meridian, Idaho, claims that a bee should not be required to travel more than a mile and a half on plain wing-power to gather his honey and pollen. But bees are great travelers and have probably taken advantage of additional means of locomotion for centuries. For example, the *Encyclopedia Brittanica* states that it is believed the honeybee originated in southern Asia, and was first imported to New England in 1638. Evidently bees are highly mobile, for they now travel to their destinations by way of truck, railroad, and airplane.

Bees are frequently sent on short trips or "vacations" for their health, especially to get away from poisonous spraying or inclement weather. In the spring, beekeepers of the Boise Valley move their colonies into the nearby hills to feed on brush and chokecherries. After a winter of living off the stored honey, they become more or less self-supporting in the hills, and when alfalfa and sweet clover begin to bloom, they are moved back into the agricultural areas of the valley.

Longer journeys are taken by honeybees, as they follow the honey flow. It is estimated that 800 colonies of bees are on the Orland, Calif., project the year round—and that an additional 800 hives are brought into the district by migratory beekeepers for an indefiinite period. These bees are considered workers for the community and aid in pollination and also supply honey for commercial purposes.

Perhaps most of these migrant bees come from the San Luis Valley in Colorado with its more than 30,000 colonies, as the project engineer writes that approximately 90 percent of the bees are migrated to other parts of the Nation, mostly Texas and California, during the winter months, to aid in the pollination of fruits. A small percentage of the bees are kept in the Valley during the winter, and beekeepers "spoon-feed" these stay-at-homes on soybean flour and sugar sirup.

Mr. Ault, the Weslaco, Tex., apiary owner, ships colonies north after the citrus trees stop blooming in the spring and returns them to the Rio Grande Valley later in the season. He has developed a commercial "winterover" feed which is also used to start brood rearing before natural pollen is available.

"Package Bees"

More exclusive transportation is provided for "package bees." Packages made up in Glenn County, Calif., consist of a small screen cage large enough to hold three pounds of worker bees (a pound of bees averages 5,000 to 7,000 individual bees). The queen and six worker bees travel in a deluxe compartment within the package. Room service is provided by means of a quart can of sugar sirup which is attached in the top of the package and is considered sufficient for a 10-day trip, and "air conditioning" is carefully controlled. These package shipments are used to restock hives that have lost their bees through the cold winter months in the northern States and Canada.

Recently six queen bees, valued at $100 per queen, each with two mates and a private compartment, were flown to Australia by the University of California to improve Australian hives.

The package bee business in California's Sacramento Valley is large, with an estimated 125,000 packages shipped annually. At an average of 2½ pounds, this allows 150 tons of bees, with a value of well over a half million dollars to leave the valley each season.

Packaged bees are transported into Region VI from the south to replenish natural colony losses, and to stabilize bee population. The Regional Director states that it has been noted that air transport is being used for this purpose.

Beekeepers in the San Luis Valley, Region V, also buy package bees in the spring to use during the following season.

Although pollination appeared to be the main concern in the reclamation area, this does not mean that the production of honey can be overlooked as a means of supplementing the farm income. According to the 1946 honey producing report, California leads all the States in the production of honey, followed by Minnesota and Iowa. During 1946 California beekeepers obtained an average of 48 pounds of honey per colony from 461,000 colonies. The total honey production was 22,128,000 pounds, which was sold for $4,526,000 or approximately 20 cents per pound, received by the producers. The United States production for that year was 213,814,000 pounds.

The latest reports from Bureau of Reclamation projects indicate that honey is paying off at the Boise, Idaho, and Yakima, Wash., projects, and the San Luis Valley project in Colorado, where the total of 30,000 colonies makes this project the largest honey producer in the State.

An experiment in Arizona, reported by the district manager of the Gila project demonstrates how honey, as a byproduct, can add revenue to the farmer's budget. Bureau of Reclamation officials persuaded a local beekeeper to put 80 stands of bees on tract 9 to insure better pollination of 40 acres of ranger alfalfa being grown for seed purposes. A total of 7,800 pounds of honey was produced and sold for $1,326, or slightly more than 17 cents per lb. As tract 9 was isolated from the surrounding alfalfa fields, there is assurance that all of the nectar and pollen was gathered from these 40 acres. The return from honey alone was approximately $33 per acre, entirely apart from the value of the increase in seed production which resulted from the pollination carried on by bees.

Mrs. E. J. Walker, whose articles covering various aspects of beekeeping are carried by a number of Texas journals, reports an unusual use for honey: Experiments have been made in soaking seeds 4 hours in 1 part of honey to 99 parts of water, which reportedly tripled the yield of seeds.

Evidently beekeeping does have a place in reclamation planning, and furthermore reclamation farmers, particularly orchardists, have already made a place for the honeybee, fully appreciating its primary value for pollination, and its secondary honey-producing potentialities.

A word of advice was given by the Regional Director of Region VII:

"Veterans who settle on reclamation projects and have an interest in bee culture, are strongly advised by entomologists to learn all they can about bees from their agricultural agents before starting their first colonies. The farmer with little or no knowledge of bees is liable to find his hard-earned cash all going into bees, bee-stands, and sugar, with little or nothing in return, experts agree."

So—*never* underestimate a bee.

Safety on Reclamation Projects

by A. R. Hines,

Safety Engineer, Bureau of Reclamation

Reclamation projects in the West require a multitude of correlated operations from the time the project initially takes shape on the drafting table until the first irrigation water finally is brought down the farmer's ditch.

Safety plays its part as one of the elements that goes into the construction and operation of any Reclamation project. To the casual visitor who first views a project under construction or in its final operating stage, many of the safety features may not be apparent at first glance.

The Bureau safety program is concerned with the protection of both personnel and property whether in the design, construction or operating stage. In general, the safety program is concerned with the prevention of accidents as it pertains to Bureau employees or contractors engaged on Bureau work. However, the responsibility for the protection of the public is not overlooked. Every reasonable precaution is taken to protect the public from possible injury in connection with, or as a result of, any work or operation of the Bureau of Reclamation. It has been found advisable in some instances to erect vista houses where the public can get a view of the work in progress without entering construction zones. In other cases, visitors are conducted about by experienced guides who give constant consideration to the safety of the group.

In order to carry out a sound and practical safety program, a safety handbook was issued to provide standards and procedures for the guidance of all employees of the Bureau. Provisions for accident prevention also are incorporated into all contract specifications and form the basis for the safety measures to be taken by contractors performing work under jurisdiction of the Bureau.

Since every hazard cannot be eliminated or every accident avoided by the simple process of complying with a set of safety rules, accident prevention becomes largely a matter of personal behavior. To help develop the proper attitude and behavior on the part of supervisors and employees, certain techniques and tools of safety education are employed.

Safety Training

Safety training is planned as an integral part of the job. When new steps in the work program are planned and laid out, such steps include consideration of the safe method of accomplishment. Foreman and other supervisors are responsible for properly instructing their men, and "follow through" to see that instructions are understood and properly carried out.

Sample safety poster.

Safety meetings are used as an important part of promoting safety as well as a means of providing safety education to all concerned. The size and composition of these meetings depend upon the type of work under way on any particular project. Meetings composed of supervisors, all foremen, or all members of a craft, are held each month for the purpose of renewing the safety record; to consider the schedule of safety activities planned for the ensuing month; to receive safety instructions; to discuss correction of physical hazards and unsafe work methods encountered.

First-Aid Training

First-aid training is also recognized as an effective means of promoting safety and is sponsored by the project safety organization. All classes are conducted according to the standards of the American Red Cross or the Bureau of Mines. Where practical, all foremen are required to have first-aid training so that in case of an accident proper first-aid care may be rendered.

Suggestion System

A suggestion system is used as a means of stimulating employees' interest in the improvement of working methods. Suggestion boxes are provided as an easy method of obtaining new ideas on safety.

As a further means of providing safety education, full use is made of posters, signs, displays, bulletins, and magazines.

In the standard method of computing accident statistics, reference is generally made to the frequency and severity rates of an establishment. The frequency rate is defined as the number of lost time injuries per 1 million man-hours of exposure. This rate is obtained by multiplying the number of injuries occurring by 1 million, and then dividing the product by the number of man-hours that were worked during the period under consideration. The severity rate is defined as the number of days of lost time (due to injuries) multiplied by 1,000 and divided by the number of man-hours of exposure. The standard frequency and severity rates serve as a "barometer" to indicate the effectiveness of the safety program. They also are used as a means of comparing the relative safety standing of organizations performing similar types of work.

On the above basis, the "barometer" shows that the frequency and severity rates for Bureau employees have decreased from 36.5 and 2.59, respectively, in 1939 to 25.1 and 2.17, respectively, for the year ending December 31, 1946. During the same period, contractors engaged on Bureau work as a whole have lowered their yearly frequency rate from 84.6 to 46.1 and reduced the corresponding severity rate from 10.11 to 6.66.

Hazards of Tunneling

Tunneling is recognized as the most hazardous of construction jobs. Due to the relatively small number of men that can be employed, a high accident frequency rate is expected. It is difficult to convert early accident reports into modern frequency and severity rates. However, striking contrasts are found in the following notes on Reclamation tunnels. According to reports of the disasters following the construction of the Gunnison tunnel (see August 1946 RECLAMATION ERA) between 1905 and 1909, 26 men lost their lives and over 100 suffered serious injury.

On the Alva B. Adams tunnel of the Colorado Big-Thompson project (see July and August RECLAMATION ERA) two fatal accidents occurred during the total period of some 2,800,000 man-hours of contract work required to drill and concrete this 13-mile tunnel from 1940-46. The frequency rate was 114.0 and the severity rate was 5.81.

On May 18, 1941, J. A. Tertelling & Sons holed through the $1\frac{1}{4}$ mile long Tule Lake tunnel on the Klamath project without a single lost-time accident.

NEWS ROUND-UP

More Reclamation Farms Available

The Bureau of Reclamation has announced the opening of 10,065 acres of land in Wyoming which will be divided into 99 homestead farms on two of its projects, the Riverton project and the Heart Mountain division of the Shoshone project.

These openings mark the fifth and sixth public land openings since the War. There will be 6,850 acres, comprising 68 farms on the Riverton project and the time for filing applications during the veterans' preference period will expire at 2 p. m. October 8. Applications should be filed with the Project Engineer, whose address is Bureau of Reclamation, Post Office Building, Riverton, Wyo.

On the Heart Mountain division of the Shoshone project 3,215 acres which will provide 31 farm units will be opened to entry. Applications for these homesteads should be filed with the Acting Project Superintendent, Bureau of Reclamation, Powell, Wyo. The veterans' preference period for filing applications on this project will expire at 2 p. m. October 22. As in the case of the settlers on the Gooding division of the Minidoka project in Idaho, qualified veterans whose applications are approved for farm units on the Riverton and Heart Mountain projects will be given a "bonus" in the form of barracks buildings, located at the evacuated Shoshone Heart Mountain War Relocation Authority camp. These can be converted into living quarters and farm buildings.

Additional information on these land openings can also be obtained by writing the Regional Director, Bureau of Reclamation, Stapleton Building, Billings, Mont., or Commissioner, Bureau of Reclamation, Interior Building, Washington 25, D. C.

Governor Dewey Visits Shoshone Project

Gov. Thomas E. Dewey, his family and other members of his party, who were guests of Senator E. V. Robertson of Wyoming, visited the Shoshone project during the latter part of July.

Regional Director K. F. Vernon and Acting Project Engineer W. F. Kemp of the Bureau of Reclamation conducted the tour over the project. Included in the visit were stops at the Heart Mountain division, Garland division, and the storage works at Buffalo Bill Dam. When the Governor was escorted to a high vantage point where he was able to get a broad view of entire project set in the green valley as contrasted with the surrounding barren nonirrigated area, he seemed greatly impressed by the sight and the value of reclamation so graphically presented.

The Governor's visit to the project was preceded by a luncheon at Cody, Wyo., given in his honor by the American Legion and the Cody Club. Approximately 300 guests were in attendance.

Interim Colorado River Basin Report Sent to Congress

An interim report containing a comprehensive inventory of potential Reclamation projects for developing water and related resources of the Colorado River Basin was sent to the Congress by Secretary of the Interior J. A. Krug on July 24, 1947. The report now contains the comments of the seven Colorado Basin States to which it was submitted for review in June 1946.

With the interim report, Secretary Krug transmitted to the Congress his conclusions that:

A comprehensive plan of development for the Colorado River Basin cannot be formulated at this time;

Further development of the water resources of the Colorado River Basin, particularly large-scale development, is seriously handicapped, if not barred, by lack of a determination of the rights of the individual States to utilize the waters of the Colorado River system. The water supplies for projects to accomplish such development might be assured as a result of a compact among the States of the separate basins, appropriate court or congressional action, or otherwise;

The States of the Upper Colorado River Basin and the States of the Lower Colorad River Basin should be encouraged to proceed expeditiously to determine their respective rights to the waters of the Colorado River consistent with the Colorado River compact.

The Basin States—Wyoming, Colorado, Utah, Nevada, California, Arizona, and New Mexico—still have before them the question of settling their respective claims to the waters of the Colorado.

However, in accordance with existing congressional authority, the Bureau of Reclamation and other Interior Department agencies are proceeding with engineering and economic studies hoping for early agreement among the States for some other arrangement that would clear the way for further development of the resources which are now going to waste.

Secretary Krug explained that he hoped that the interim report to the Congress, by making full details of the problem available to all interested parties, would help to expedite a solution.

The problem hinges on the fact that the Colorado River system does not normally yield sufficient water for all of the potential Reclamation developments.

Comprising about one-twelfth of the land area of the United States and located in the southwestern corner of the Nation, the basin is a vast, rugged, arid area. Virtually all economic activity and civilized life there depend upon the conservation of water resources, irrigation of the land, and development of hydroelectric power from the streams of the Colorado River system. At the present time, the basin's population growth and its irrigation, hydropower and other water resource needs are outstripping developed water and related resources.

The construction of some of the major Reclamation developments in the Basin, including Hoover, Parker, and Davis Dams and other irrigation and hydropower facilities, was made possible under the Colorado River compact of 1922.

Uncle Sam Says

Did you ever can a United States Savings Bond? Don't answer "no" too quickly because that's what millions of wise Americans are doing daily. By buying bonds regularly through the Payroll Savings Plan where they work or the Bond-a-Month Plan where they bank, they are preserving income for future nourishment. Savings Bonds grow in nutrition value to you and your family through the passage of time. In 10 years they will produce $4 in goodness for every $3 you store away today. Yes sir, the best canning you can do now is the canning of income in the form of Savings Bonds.

U. S. Treasury Department

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

2. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, 7-page mimeographed study with graphs.

3. *Questions and Answers About Forming an Irrigation District to Further Irrigation Under the Missouri Basin Development Project—Montana.*—Eight-page folder available upon request to the Regional Director, Bureau of Reclamation, Billings, Mont.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *High-Pressure Reservoir Outlets,* by J. M. Gaylord and J. L. Savage—a report (1923) on Bureau installations compiled from correspondence, project histories, feature reports, technical papers, special reports prepared for this purpose, and from personal inspection of the installations described. Obtainable from the Superintendent of Documents.

2. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

3. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are: Problem 10, Pattern of Rural Settlement—25 cents, and Problem 28, Local Governmental Units—70 cents.

Problem 9 (Supplement), Standards and Levels of Living—20 cents.

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 24, Agricultural Processing Industries—30 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

4. *Central Valley Project Studies.*—Studies of diversified but interrelated problems affecting the wartime and long-term development of the Central Valley Project in the State of California. Obtainable from the Superintendent of Documents. First released in the series are Problems 1–5, The War Program—45 cents.

5. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

6. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

Reclamation's Construction Program (Continued from page 194)

Utah

NEWTON: $50,000; complete Newton Dam and Reservoir.

OGDEN RIVER: $55,000; continue construction on south Ogden district lateral system.

PROVO RIVER: $1,370,000; construction on Salt Lake aqueduct and Jordan Narrows siphon.

SCOFIELD: $40,000; additional work on dam and reservoir.

REGION V (HEADQUARTERS, AMARILLO, TEX.)

Oklahoma

W. C. AUSTIN (formerly Lugert-Altus): $2,960,000; complete main canals and work on laterals and drainage system.

New Mexico

CARLSBAD: $40,000; construction on canal and drainage system.

TUCUMCARI: $1,790,000; complete canal and laterals for first five units; work on drainage.

New Mexico-Texas

RIO GRANDE: $1,480,000; complete Elephant Butte Spillway construction of transmission line and substation.

Colorado

SAN LUIS VALLEY: $240,000; Platoro Dam specifications and investigational and developmental work.

Texas

VALLEY GRAVITY: $250,000; preconstruction surveys and preliminary designs.

MARSHALL FORD DAM: $80,000; minor construction.

BALMORHEA: $70,000; completion of protective works and other construction.

REGION VI (HEADQUARTERS, BILLINGS, MONT.)

Montana

SUN RIVER: $30,000; survey and design studies on drainage facilities.

CANYON FERRY: $600,000; to initiate construction.

FORT PECK: $3,160,000; construction on Glendive-Miles City and Fort Peck-Williston transmission lines, and substations.

MOORHEAD DAM: $960,000; start dam construction.

YELLOWSTONE PUMPING UNIT: $200,000; work on irrigation system.

North Dakota

HEART RIVER: $700,000; including start of construction on Heart Butte Dam and Dickenson Dam.

CANNONBALL DAM: $400,000; start dam construction.

South Dakota

ANGOSTURA DAM: $3,900,000; continue dam construction, and start irrigation construction.

GRAND RIVER including SHADEHILL DAM: $800,000; start dam construction.

BIXBY DAM: $500,000; start dam construction.

Wyoming

BOYSEN DAM: $2,600,000; continue dam construction.

KORTES DAM: $3,400,000; continue dam construction.

KEYHOLE DAM: $200,000; start dam construction.

RIVERTON: $2,185,000; canal system construction and work on drainage system; development of 15,000 acres of irrigable lands for settlement.

SHOSHONE: $3,150,000; canal laterals and transmission line and development of 15,000 acres irrigable public lands on Heart Mountain Division for settlement.

REGION VII (HEADQUARTERS, DENVER, COLO.)

Colorado

COLORADO-BIG THOMPSON: $18,320,000 (including supplemental appropriation needed); continue construction on Granby reservoir and Granby pumping plant, Horsetooth Reservoir and feeder canals, Estes Park aqueduct and power system; Estes Lake; start Olympus Dam; transmission lines.

NARROWS DAM: $300,000; start dam construction.

BONNY DAM: $800,000; start dam construction.

Wyoming

KENDRICK: $1,040,000; continue work on canal and laterals.

Nebraska

ENDERS DAM: $2,400,000; continue dam construction.

CULBERTSON DAM: $300,000; start dam construction.

MEDICINE CREEK DAM: $1,000,000; start dam construction.

MIRAGE FLATS: $190,000; construction Box Butte Dam and canals.

BOSTWICK UNIT: $500,000; for irrigation facilities.

FRENCHMAN-CAMBRIDGE UNIT: $1,700,000; for irrigation facilities.

Kansas

CEDAR BLUFF DAM: $900,000; start dam construction.

U. S. GOVERNMENT PRINTING OFFICE 1947

NOTES FOR CONTRACTORS

Contracts Awarded During July 1947

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1670	Colorado River Front Work and Levee System, Colo.	July 24	One 20-inch floating cutter-type hydraulic suction dredge complete with fuel, work and pipe barges, and power attendant plant.	Pacific Coast Engineering Co., Alameda, Calif.	$871,700.00
1727	Colorado-Big Thompson, Colo.	July 25	Four oil-immersed outdoor-type transformers for Granby switchyard.	General Electric Co., Denver, Colo.	141,164.00
1727	do	July 25	Three transformers and three power circuit-breakers for Granby switchyard.	Westinghouse Electric Corp., Denver, Colo.	112,297.00
1727	do	July 3	Disconnecting switches for Granby switchyard.	Graybar Electric Co., Inc., Denver, Colo.	17,870.54
1773	Shoshone, Wyo.	July 2	One 25-ton traveling crane for Heart Mountain power plant.	Euclid Crane & Hoist Co., Euclid, Ohio.	16,885.00
1789	Central Valley, Calif.	July 10	Circuit-breakers for Keswick power plant.	General Electric Co., Denver, Colo.	51,139.00
1790	Boulder Canyon, Ariz.	July 24	Transformers, circuit-breakers, disconnecting switches and instrument transformers for Boulder City and No. 2A pumping plant substations.	Westinghouse Electric Corp., Denver, Colo.	39,556.44
1799	Davis Dam, Nev.	July 24	Dismantling, moving and erecting shop building at Government camp.	W. S. Ford, Kingman, Ariz.	24,510.00
1800	Central Valley, Calif.	July 24	One 100-ton gantry crane for Tracy pumping plant.	Cyclops Iron Works, San Francisco, Calif.	104,409.00
1804	Colorado-Big Thompson, Colo.	July 16	One 30-inch ring-follower gate with hydraulic hoist for Granby Dam.	Westinghouse Electric Corp., Sunnyvale, Calif.	11,835.00
1804	do	July 16	One 30-inch hollow jet valve for Granby Dam.	Pacific Coast Engineering Co., Alameda, Calif.	10,800.00
1806	Columbia Basin, Wash.	July 7	One transformer for Granby power plant.	Westinghouse Electric Corp., Denver, Colo.	38,800.00
1811	W. C. Austin, Okla.	July 11	Construction of earthwork and structures for laterals and sublaterals.	Stigler Construction Co. and Jack Durrett, Stigler, Okla.	349,416.00
1814	Columbia Basin, Wash.	July 11	Construction of six relift pumping plants for laterals.	James Construction Co., Seattle, Wash.	68,016.25
1826	Central Valley, Calif.	July 24	Dismantling, moving and converting buildings for Government camp at Lindsay, Calif.	Paul Spencer Construction Co., Los Angeles, Calif.	153,498.61
1826	do	July 24	Construction of water and sewerage systems for Government camp at Lindsay, Calif.	Kovick Bros. Construction Co., Fresno, Calif.	11,675.00
1827	do	July 8	Autotransformers and regulating transformers for Delta substation.	Allis-Chalmers Mfg. Co., Denver, Colo.	1,249,380.00
1827	do	July 8	Transformers and circuit-breakers for Delta and Elverta substations.	Westinghouse Electric Corp., Denver, Colo.	1,272,876.00
1827	do	July 8	Circuit-breakers for Delta and Elverta substations.	Pacific Electric Mfg. Corp., San Francisco, Calif.	192,286.00
1827	do	July 8	Circuit-breakers for Delta and Elverta substations.	General Electric Co., Denver, Colo.	114,864.00
1833	Yakima-Roza, Wash.	July 9	12 sets of motor-control equipment for pumping plants.	Allis-Chalmers Mfg. Co., Denver, Colo.	185,891.00
1843	Columbia Basin, Wash.	July 8	Miscellaneous structural steel, railings and gratings for Grand Coulee power plant.	Pacific Car & Foundry Co., Seattle, Wash.	11,952.00
1844	Central Valley, Calif.	July 15	Structural steel, siding, windows and doors for steel warehouse at Tracy pumping plant.	Independent Iron Works, Oakland, Calif.	22,063.00
1847	Colorado-Big Thompson, Colo.	July 23	Discharge valve control system, two hydraulic pumping units, and pressure tanks for Granby Pumping Plant.	Woodward Governor Co., Rockford, Ill.	55,445.00
1858	Shoshone, Wyo.	July 25	Carrier-current coupling apparatus for Heart Mountain power plant and Garland substation.	General Electric Co., Denver, Colo.	21,247.00
1861	Colorado River Front Work and Levee System, Calif.	July 10	Furnishing six 2-bedroom prefabricated houses for Needles, Calif., Government camp.	Green Lumber Co., Laurel, Miss.	16,080.00
1862	Davis Dam, Nev.	July 31	Furnishing 20 prefabricated houses for Davis Dam Government camp.	Green Lumber Co., Laurel, Miss.	49,935.00
1883	Riverton, Wyo.	July 31	Construction of 13.7 miles of the Wyoming Canal.	Morrison-Knudsen Co., Boise, Idaho.	668,933.00

Construction and Supplies for Which Bids Will Be Requested During September 1947

Estimated date bids to be invited	Project	Description of work or material
Sept. 1	Davis Dam, Ariz.-Nev.	Construction of 83 miles of 230-kv. transmission line from Davis Dam to Parker Dam. Steel structures and towers.
Sept. 1	Boulder Canyon, Nev.	Construction of 22 by 55 feet reinforced concrete pump house No. 2A in vicinity of water-treatment plant north of Boulder City, Nev.
Sept. 1	Tucumcari, N. Mex.	Construction of drain inlets and farm and operating bridges, Conchas Canal.
Sept. 1	W. C. Austin, Okla.	Construction of Ozark laterals and structures for irrigation of 9,300 acres of land near Altus, Okla.
Sept. 1	Canyon Ferry Unit, Missouri Basin, Mont.	Construction of 11 miles of relocated road in western Montana.
Sept. 1	Colorado-Big Thompson, Colo.	Construction of 10 miles of Horse Tooth Feeder Canal, including a diversion dam on the Big Thompson River, and concrete and steel siphons, near Loveland, Colo.
Sept. 1	Missouri Basin, Colo.-Nebr.	Construction of 45 miles of 115-kv., wood pole, transmission line from Sidney, Nebr., to Sterling, Colo.
Sept. 1	Colorado-Big Thompson, Colo.	Construction of 20 miles of 115-kv., wood pole, transmission line from Greeley to Loveland, Colo.
Sept. 2	Central Valley, Calif.	Excavation, concrete footings, and gravel surfacing for Keswick switchyard at Keswick Dam, near Redding, Calif.
Sept. 15	Boulder Canyon, Nev.	Laying 6 miles of 12- and 14-inch diameter steel pipe, and erection of 50,000- and 2,000,000-gallon storage tanks at Boulder City, Nev.
Sept. 15	Boise-Payette, Idaho	Construction of earthwork and structures for Sand Hollow Wasteway, near Caldwell, Idaho.
Sept. 15	do	Construction of earthwork and structures for Willow Creek Wasteway, near Middleton, Idaho.
Sept. 15	Deschutes, Oreg.	Construction of earthwork and structures for lateral system to serve 8,500 acres of land near Madras, Oreg.
Sept. 15	Owyhee, Oreg.	Construction of Locket Gulch Wasteway on North Canal and Owyhee Ditch Crossing near Nyassa, Oreg.

NEXT MONTH

How water is made to run uphill in the Central Valley project of southern California.

ALSO—"The Man Behind the Gun"—describing the latest methods of applying gunite linings to canals.

Progress at Davis Dam

Here is the first bucket of concrete being poured into the gravity wall foundation cut-off trench at Davis Dam in Ariz.-Nev. The main purpose of Davis Dam is to generate electrical energy and to reregulate the Colorado River, below Hoover Dam, through the provision of storage for irrigation and domestic use within the United States and for the delivery of water at the U. S.-Mexico international boundary.

v. 33, no. 10

OCTOBER 1947

Harvest Issue

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Featuring:

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RECLAMATION'S CROP RECORD

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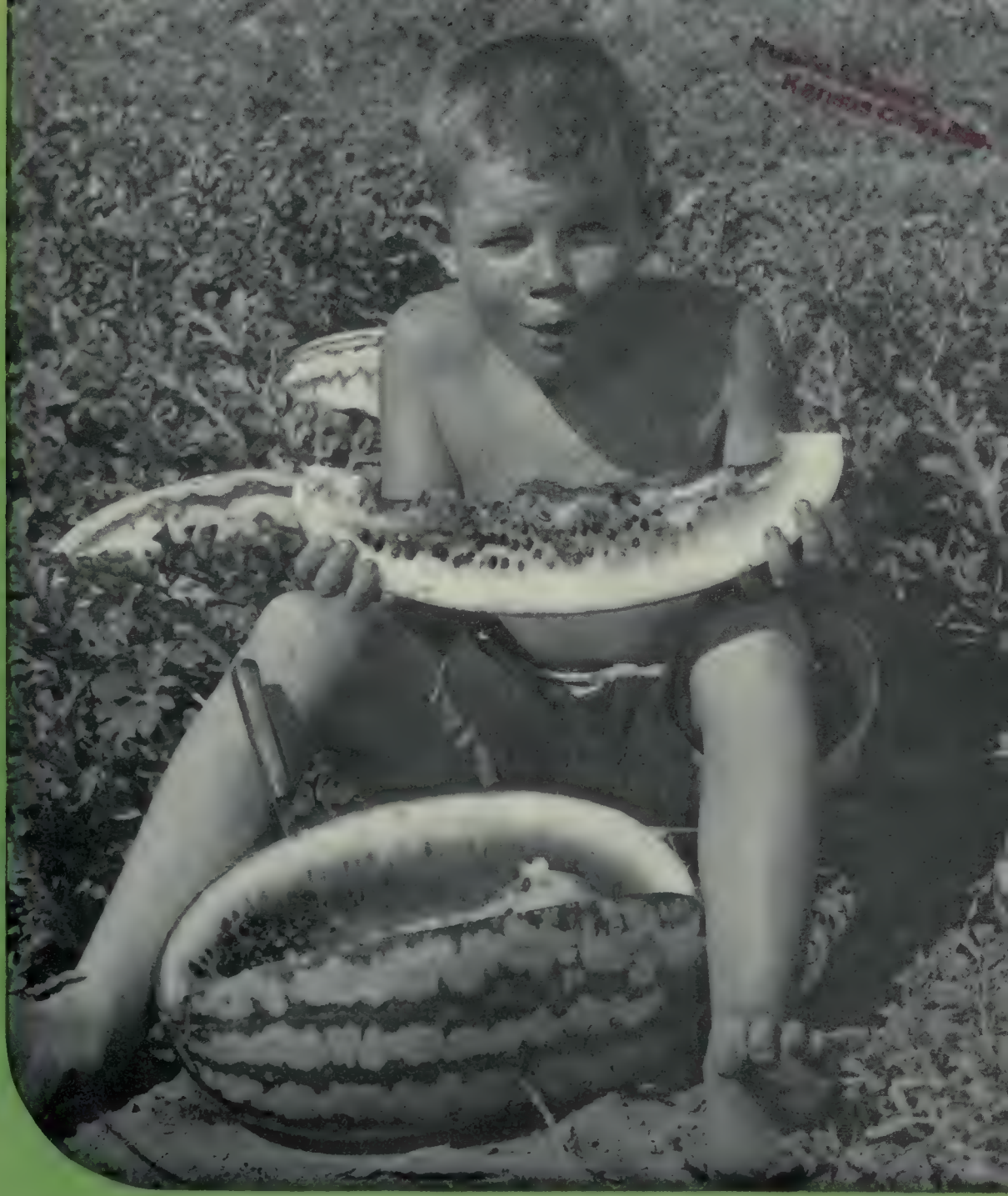
WATER REPORT



THE Reclamation ERA

Corfitzen Goes to Greece

William E. Corfitzen

William E. Corfitzen of the Bureau of Reclamation will become irrigation adviser in the rehabilitation of irrigation works on 800,000 acres in northern Greece, as part of the American mission for aid to that country, Commissioner Straus recently announced. Corfitzen, special representative of the Commissioner, has been loaned to the State Department for 1 year for that purpose.

Mr. Straus, at the time of the announcement said "Rehabilitation of the irrigated areas of Greece will help materially in restoring the food-production capacity of that country." He also pointed out that the war damage in Greece and incidental deterioration of canals, headworks, and turnout structures had been tremendous, and that restoration of the efficiency of these works will be a distinct boon to Greece's self-support.

Corfitzen's job will be that of expediting the reconstruction with the goal for the completion of this task tentatively set for June 1948.

During the past few years Corfitzen has been principal liaison officer for the Bureau with irrigation officials of 31 foreign nations who have called upon the United States for counsel and aid in developing their own agricultural resources through irrigation. This cooperative program involved the exchange of technical data, receiving foreign officials, providing in-service training for foreign engineers on Bureau of Reclamation projects, and performing irrigation and multiple-purpose investigations and designs for several nations. The outstanding feature of the program was the preliminary design job on the enormous Yangtze Gorge project for China which was supervised by consultant John L. Savage and paid for by the Chinese Government.

"Nations the world over have begun to look to the Bureau of Reclamation for guidance in the development of land and water resource development," Corfitzen said. In commenting on his latest assignment he stated, "The program in Greece is designed to restore to full usefulness the lands in Macedonia and Thrace which have been irrigated for many years, and which supply a principal part of the food grown in Greece."

Corfitzen joined the Bureau in 1933 and has spent considerable time on special research on the problems of sedimentation in canals, and water conservation and utilization, previous to becoming Chief of the Special Assignments Division. He is a graduate of Worcester Polytechnic Institute of Massachusetts and the Denver University Law School. ●

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Ruth F. Sadler, *Editor*

Our Front Cover

Indian Summer in Idaho

Eating 'em right off the vine is a never-to-be-forgotten thrill. And who enjoys it more than a barefoot boy? Jack Massey of Boise, Idaho, illustrates the real way to eat watermelon. Living in the land of irrigation he has an advantage of several additional months for enjoying this luxury. See *Watermelon Time* by Elma Hill Neal on page 226. The photo was taken by Stanley Rasmussen, Region I.

Letters to the Editor

For the People . . . .

The following letter was received from Dr. Charles A. Lory, well-known authority on irrigation, whose comments are greatly appreciated by the editorial staff.

FORT COLLINS, COLO., *August 19, 1947.*

DEAR DIRECTOR LINEWEAVER: Thank you for your letter of July 25 and the return of the photograph used in the July issue of the RECLAMATION ERA to illustrate my article. It was a pleasure to write of my experience as a ditchrider. It recalled many interesting pioneer conditions.

I find the ERA interesting and instructive. For years it was a first-class engineering journal on construction of irrigation structures. Now its editors are giving attention to the people who operate these and to the folks on Reclamation project farms. This is proving helpful to the operation and maintenance staffs, and particularly to the farmers.

While methods of irrigation must be adapted to local conditions, beginners in irrigation farming especially, and irrigation farmers generally, would be helped by articles on irrigation methods of growing crops where rainfall is supplemented with "ditch water."

With kindest personal regards,

Cordially,

CHARLES A. LORY.
President, Emeritus, Colorado State College.

Education Via Era

LOGAN, UTAH, *August 12, 1947.*

DEAR EDITOR: Looking toward improvement of irrigation and drainage facilities in Moapa Valley, Nev., the Bureau Region III officials, as you know, are conducting comprehensive and detailed investigations. It is expected that the report of the Bureau's Moapa Valley studies will be ready about July 1, 1948.

The problem of educating farmers and businessmen with respect to Bureau of Reclamation activities, and the value of Bureau projects, is sometimes a perplexing one. It is perhaps more true in outlying valleys—long-settled, like Moapa—than in some of the valleys more recently settled. I believe that wide circulation of the RECLAMATION ERA in Moapa Valley and in Virgin Valley will contribute substantially to the desired understanding of the Bureau of Reclamation by local people.

Th educational problem in Virgin Valley is more perplexing than in Moapa Valley. In order to meet both needs I would like to send the RECLAMATION ERA to a large number of local people. I am enclosing a list of 28 men—13 of whom are in Moapa Valley and 15 in Virgin Valley—to whom I would like to have RECLAMATION ERA mailed for a year or more, beginning with the issue of May 1947. Please advise me if it is consistent with your policies to send the ERA to farmers who are not yet participating in a Bureau program. For the two southern Nevada valleys, Moapa and Virgin, there are three irrigation companies, and about one-half of the men whose names are listed on the attached sheet are directors in an irrigation company. Advise also in connection with a subscription for 28 men—what subscription rate would be in harmony with Bureau practices?

Thank you for an early response.

Yours very truly,

O. W. ISRAELSEN,
PH. D., Consulting Engineer.

Reader Israelsen was informed that the special 50-cent rate applies to irrigation farmers in the West who are present or potential users of water made available through Bureau of Reclamation projects.—Ed.

Bureau Booster

MINDEN, NEV., *August 16, 1947.*

DEAR MRS. SADLER: For more than 20 years I have made it an absolute rule never to release any material for use in an uncopyrighted publication, but the entire personnel of Region III (and there has never been an exception) have always given me such all-out cooperation, that when Arthur Rydell and William Russell asked for the enclosed article on the Hoover Dam Guide Service for the ERA, I could not say no.

All existing rights in this article are my personal property and you need no authority, other than mine, to use it.

You have my permission to publish it in the ERA and to make any other use of it which will in any way, directly or indirectly, help the Bureau.

Cordially yours,

DONLEY LUKENS,
The Nevada Magazine.

Gratefully and proudly we took Reader Lukens at his word.

SEE NEXT PAGE

Californians, Have Mercy!

SACRAMENTO, CALIF., *August 23, 1947.*

To: Mrs. S.
From: Mr. C.
Subject: Tragic Error in "Next Month" Section of September ERA.

DEAR MADAM: Do you want to get yourself murdered? The Central Valley project in southern California, indeed! Southern California is Los Angeles and surrounding territory south of the Tehachapis which wall off the Central Valley in the south. The Central Valley is northern California, or if anyone prefers, central California. We feel deeply about these things out here.

O. C.

Sorry! We meant to say "sunny" California, of course.—Editor.

United States Department of the Interior

J. A. Krug, Secretary

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THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

Sincerely,

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HOOVER DAM

• • • • • from the Guide's Viewpoint

by Donley Lukens

Extracted from *The Nevada* magazine (see *Letters to the Editor*)

What is probably one of the most efficient public services in the world is operated by a little group of 22 civil service employees at Hoover (Boulder) Dam. They are the guides who conduct visitors through the dam, and whom Nevadans and tourists alike take for granted.

If there is a similar organization in the world that can equal the safety record of these men, or show a higher percentage of satisfied customers, diligent search has not revealed it.

Up to closing time May 27, 1947, the Hoover Dam Guide Service had conducted 2,200,680 visitors through the dam and directed the movement of twice that number on top of it without a single fatality. The most serious casualty any visitor had suffered on a conducted tour was a badly bruised finger, while a broken leg represented the worst injury on top of the dam.

Add to this safety record the fact that during the 6 years 8 months the dam has been open to the public, allowing for the time it was closed during the war, there have been less than a hundred complaints from all causes.

One of the things which has made this record possible is the type of men the service attracts. Three members of the staff hold master's degrees, three were on the construction job, and a large percentage of them are college men, but all are especially qualified for the work.

A complete list of the qualifications required of a good guide sounds like the curriculum for a Ph. D., but the most important, and the one which they must demonstrate before they are allowed to conduct a party on their own, is a quality of leadership that will enable them to handle a crowd in a closed place, during an emergency, without panic. The importance placed on this requirement undoubtedly accounts for the safety record of the guide service.

The first aid which guides are called upon to give is usually limited to fainting cases, but there is a first-aid man on duty in a special first-aid room at all times and two members of the guide staff are also experts. Jack Arnold was a warrant officer in the Navy Hospital Corps and John Weston was in the Army Medical Corps.

But these things are only the start of the qualifications of a good guide. Besides being capable leaders and first-aid men they must also be teachers and entertainers, capable of answering all manner of questions.

To keep abreast of the questions, not only about Hoover Dam and Lake Mead but other projects of the Bureau of Reclamation they must study continuously.

One of the secrets of their success is that no question is foolish to a good guide, and this is not just a copy book axiom laid down for them to follow. If you get to know the men well enough you will realize that although they see the humor in many questions asked they really take them seriously, because they feel they are serious to the people who ask them. There is one exception to this rule, and that is the tourist who asks the first question that pops into his mind just to start a conversation. Guides soon get to recognize this circumstance and help the conversation along.

The two most frequently asked questions which would bring a snicker from most of us are:

"Is the water good to drink after you have taken the electricity out of it?"

And referring to the high-water mark on the canyon walls left by the waters of Lake Mead, "Why do they paint that white line on the canyon wall?"

Another question which every guide hears almost daily is "How many men are buried in the concrete?" A surprisingly large number of visitors will argue the point with the guides when they are assured that no one was buried in the concrete during the construction period.

Some of the less frequently asked questions which are none the less amusing are:

"Aren't you going to show us any electricity?"

"What kind of fuel do they use to run the hydroelectric turbines?"

"Did the building of the dam increase the size of the lake?"

"Why did they build the dam here instead of in Los Angeles where they use most of the power?"

A feeling of hospitality and the ability to be a gracious host are also among the important qualifications of the guides. They are demonstrated countless times every day by the performance of numerous little courtesies which range all the way from helping a young mother find a place to heat the baby's bottle to helping those who outlasted their luck at the gaming tables hitch-hike rides to practically every part of the United States.

The guides probably find more amusement in listening to the misinformation which some of the tourists volunteer to other members of the party than from any other source.

One self-styled authority pointed out the 150-ton cableway which is used to transport heavy equipment from the canyon rim to the powerhouses below and explained that the cables held the sides of the canyon together so the pressure of the water behind the dam would not push them apart, leaving the dam in the middle of the stream.

Another explained that the reason the water below the dam was green was because the electricity had been removed. To avoid embarrassing him, the guide omitted the usual explanation, which is that the blue of the sky is filtered out of the light when it is reflected from the canyon walls to the water below.

Perhaps it is instances of this kind that help to attract the type of men they have in the Hoover Dam Guide Service and to keep them on the job year after year. Certainly it is not the salaries they receive—for their base pay ranges from $2,469.24 a year to $2,895.60 a year for chief guide. With all of the increases possible under civil service, this would still leave them with pay checks of from slightly under $3,000 a year to less than $3,500 a year for chief guide, and many of the men in this service could earn half again to twice their present salaries in private industry.

Donald C. Beckord, chief guide, who holds a master of arts degree and served in the late war with the rank of major, thinks the appreciation tourists show for the guide's service helps to keep the men on the job.

"Why," he says, "I get more 'thank you's' in one afternoon on this job than I received in 12 years of school teaching."

The number of people who say, "Thank you" to the guides is one of the remarkable things about the service. An eastern railroad executive who noticed it made three trips through the dam in an effort to learn the secret of the guides, and said:

"There was hardly a person on any of these tours who did not thank the guides either during or after the trip. I have been dealing with the traveling public for more than 30 years and it takes better service to get an American tourist to say 'Thank you' than it does to separate him from a fat tip.

"Any time a tourist appreciates a service enough to say 'Thank you' he will talk about it for at least a year. Money can't buy that kind of advertising, and no other advertising will bring as many tourists."

Just how many of the tourists who visit Hoover Dam come as a direct result of the guide service is anybody's guess, but it can be accurately estimated that those who have visited the dam since it opened have spent at least $88,027,200 in the southern part of the State and the visitors to the dam this year will spend at least $16,000,000 in Nevada. •

ARIZONA ~ Great Outdoor Greenhouse

How farmers cast their seed upon the Yuma and Salt River projects and it returns one-thousandfold

Photo by Ralph E. Johnston

Yuma County Agent Robert J. Moody inspecting a field of Mindo Oats on a farm in the Yuma Valley.

by Ralph E. Johnston

Economist, Project Planning Office, Phoenix, Ariz., Region III

Miracles in the world of agriculture are no longer startling.

Through the use of electrically lighted henhouses, the modern biddy produces two eggs in the time her ancestor produced one. Through the use of water dropped from the heavens upon lush areas or stony mountain sides, and diverted by the ingenuity of man to desert lands, two crops grow where only sagebrush grew before.

But the mind of man, inured as he is to pyramiding production records, cannot contemplate the increase from one bushel of wheat to 60,000 in 2 short years without experiencing something of a shock Yet exactly that increase is a matter of record—and a matter for rejoicing in Montana where in the early '40s a sawfly infestation threatened one of the Nation's chief wheat-growing areas.

Canadian plant breeders developed a strain which resisted the pest, but the supply of seed was infinitesimal in comparison to the acreage to be seeded. One bushel of wheat under ordinary circumstances would produce approximately 35 bushels in a year's time. At that rate of increase, the farmers would be bankrupt before enough fly-resistant seed could be obtained. The future looked dark. It seemed that only a miracle could save the Montana wheat growers.

Remembering the miracles wrought on the Salt River project in Arizona, where irrigation, plus 310 frost-free days a year, makes the valley a veritable outdoor greenhouse, Montanans sent one bushel of the aptly named Rescue wheat to the Arizona Agricultural Experiment Farm near Mesa. This was in the fall of 1944. The next spring 35 bushels were harvested and shipped back to Montana where a crop was produced in the spring and summer of 1945. That fall 100 bushels from that yield were sent back to Arizona, this time to the Yuma area, where a good crop was produced, resulting in 3,876 bushels being sent to Montana in May 1946. This amount plus that raised in Montana in 1945 was planted immediately. In the fall of that year, just 24 months after the first bushel had been sent to the "outdoor greenhouse," 60,000 bushels of Rescue seed wheat were available to Montana farmers.

Montana's reaction to this cooperation was expressed recently by the Montana Experiment Station and Extension Service in these words:

"The increase of Rescue wheat from one bushel in October 1945 to 60,000 bushels 24 months later sounds like a fairy story, but is nevertheless the true production record accomplished in the race to reduce the huge losses being taken by wheat producers of Montana in the battle against the sawfly.

"It also means that in 1947, instead of 7,000 acres which would have been a maximum number planted under the ordinary method of increase, there will be close to 100,000 acres of Rescue wheat planted in Montana; and this fall (1947), just 36 months after starting the program, there should be harvested enough Rescue wheat to seed every sawfly-infested acre in Montana."

Reducing the benefit to terms of dollars and cents, Montana agricultural authorities estimate that by the use of Arizona's outdoor greenhouses to hasten production of sawfly resistant (Rescue) wheat seed, Mon-

tana farmers will gain $4,467,525 during 1947 and 1948.

Montana's experience is not unique.

Other Northern States, from New York to North Dakota, have benefited from use of the irrigated lands of the Salt River and Yuma projects, developed by the Bureau of Reclamation.

New York

In the fall of 1945 small quantities of seed of four different selections of oats were sent to the experiment farm near Mesa, by the agricultural experiment station of Cornell University, Ithaca, N. Y. All of these selections were so new at that time that they were identified only by numbers. In the spring of 1946 a total of 1,325 pounds of seed was sent back to New York. Dr. H. H. Love, professor of plant breeding, New York College of Agriculture, has expressed his appreciation of this type of interstate seed increase cooperation.

North Dakota

A small acreage of a new beardless hard red spring wheat, also a new smooth awned malting barley, was planted in the Salt River Valley in the fall of 1946, by a commercial seed company. An effort is being made to increase the resulting crops in the Red River Valley of North Dakota during 1947.

South Dakota

The spring wheat growing States are constantly confronted with the problem of developing a high quality of bread wheat which has disease-resisting qualities (especially stem rust) and which produces satisfactory yields.

In the fall of 1945 small quantities of new, as yet unnamed, varieties of wheat and barley seed, developed by the South Dakota Agricultural Experiment Station to withstand rust, were sent to the Arizona Agricultural Experiment Farm near Mesa. The wheat is a cross between Rival and Thatcher, so it was designated as Rival X Thatcher, 2280. From a very few pounds planted in the fall of 1945 at Mesa, 278 pounds were shipped back to South Dakota in the spring of 1946.

Fifteen pounds of Peatland X Dryland 252 barley seed were shipped to Mesa in the fall of 1945, and the next spring a crop of 400 pounds was harvested. One hundred pounds were shipped back to South Dakota, and 300 pounds to an irrigated area in Idaho. A crop was produced in South Dakota in 1946, but a larger one was produced in Idaho because of irrigation. Thus starting with 15 pounds in the fall of 1945, because of the cooperation of the irrigated areas, more than 7,000 pounds of seed were available in the fall of 1946.

Dr. J. E. Grafius, associate agronomist, South Dakota Agricultural Experiment Station, recently said of this accomplishment:

"We greatly appreciate the help we have received in this matter. This type of help is of immense value to the northern stations in securing rapid increase of new varieties."

Iowa

The Iowa Agricultural Experiment Station developed the Clinton variety of oats for resistance to helminthosporium, a new oat disease, and other cornbelt oat diseases. Twenty-five pounds of seed were sent to Mesa in the fall of 1943, where it was planted; and in May 1944, 67 bushels (or 2,144 pounds) were shipped back to Iowa. From 25 to over 2,100 pounds in less than a year!

Minnesota

The Mindo and Bonda varieties of rapid-maturing, strong-stemmed and rust-resisting oats, were developed by the Minnesota Agricultural Experiment Station. These varieties are highly recommended for Minnesota and other States with similar oat-growing conditions. A total of 25 acres of each variety were planted in the Yuma Valley in December 1946. These fields are being grown by a Minnesota seed company in order to make available to the farmers of Minnesota larger supply of certified seed of these recommended varieties.

Two Crops Each Year

A year-round growing season plus almost absolute control of water makes possible this cooperation with other areas.

In most of the United States there is only one growing season every 12 months. This is a very definite hindrance to the plant breeders in their efforts to aid agriculture. They do use greenhouses in producing the thousands of individual plants from crosses and selections, which are necessary to obtaining new and improved varieties. Then someone discovered that the two-crops-per-year areas of the Southwest, the great outdoor greenhouses of Arizona, could assist in this work.

The Yuma area averages around 200 feet in elevation, receives a yearly average of less than 4 inches of precipitation, and has 331 days free from frost. The Salt River area averages about 1,000 feet higher than Yuma, has less than 8 inches average yearly precipitation, and 310 days free from frost, thus assuring a year-round growing season.

These normally desert areas have a semi-tropical climate which is highly advantageous to agriculture on irrigated lands. They can grow, under irrigation, any field crop that can be produced anywhere in the United States. This is possible because of the two growing seasons each year—one for the cooler months, and one for the warmer months; also, because of the more than 80 percent of possible sunshine, which is more than any other area in the United States.

Great Irrigation Systems

To these very important natural field crop growing requirements man has added the great irrigation systems of these two valleys. All crops are produced under irrigation, which means that moisture can be added or withheld as needed, and in the proper amounts. Thus, there virtually is controlled crop production, so essential in speeding up the increase in the scarce seed supplies of the new varieties of field crops. So seed is now shipped to Arizona, where a crop is produced during the noncrop growing season of the Northern States, namely, the late fall, winter, and early spring months.

This "discovery" shortens by years the time when a supply of seed of the new and improved varieties of field crops can be made available.

It is difficult to even imagine the great quantities of seed required to plant the millions of acres of field crops in the United States. Wheat acreage alone in 1944 required 65,684,000 bushels, figured at 1 bushel per acre, for planting.

To this sum must be added the millions of bushels of barley, oats, rye, flax, corn, sorghums, cotton, forage, and pasture crops, most vegetables, and a long list of other crops requiring seed.

When a Northern State has a small quantity of seed of a new variety which it wants to increase in the "great open greenhouses of Arizona," it gets in touch with the Arizona Agricultural Experiment Station.

Dr. Ralph S. Hawkins, formerly head of agronomy department, handled the work when it first started. It is now in charge of Dr. Robert L. Matlock, former extension agronomist and secretary of the Arizona Crop Improvement Association, who recently became head of the agronomy department. After all arrangements have been made, the seed is sent to the experiment farm near Mesa, where D. C. Aepli, superintendent, looks after the planting, harvesting, and return of the crop to the Northern States. The Arizona station has been most cooperative in this work, but it does not have enough land or enough personnel for its own experimental work.

Seed Growers Registered

It now looks like the future seed-increase fields will have to be planted on the farms of registered seed growers approved by the State Crop Improvement Association. This is the method followed in the Yuma area where Robert J. Moody, county agricultural agent, has taken the leadership and rendered very valuable service to this and other seed and crop improvement work.

These seed-increase fields must be grown under conditions which maintain absolutely the varietal purity, as well as all other necessary precautions to assure registered or certified seed. The Arizona Agricultural Experiment Station and the State Crop Improvement Association are cooperating to make this possible.

Thus the Salt River and Yuma projects, besides producing abundantly for their respective areas and the Nation, now render a new kind of very valuable service as outdoor greenhouses for the improvement of the country's crops. •

WATER RUNS UPHILL

(IN CALIFORNIA, OF COURSE)

by Martin H. Blote, *Chief, Irrigation Operations Division, Branch of Operation and Maintenance, Region II, Sacramento, California*

California's rich Central Valley is bone dry all summer and getting dryer as use increases.

Overdrafts on ground water menace hundreds of thousands of valuable acres. But heavy winter rains flash off bare hillsides and floods waste 9,000,000 acre-feet of precious water out to sea. The water supply is geographically all wrong, too. The Sacramento Valley, northern third of the Central Valley, gets two-thirds of the water; the San Joaquin Valley, southern two-thirds, only a third of it.

To rearrange this scant and poorly distributed water supply, the Bureau's Central Valley project will soon start water running uphill and rivers running backward. Here's how it will work: Circulation of water will begin at Millerton Lake, where the San Joaquin River is pent up behind Friant Dam. A small amount of the San Joaquin water will be allowed to trickle down to its big bend. Somewhat more will go north along the 37-mile Madera Canal. All the rest of the river will be turned south, to flow up to the head of the valley through the Friant-Kern Canal, which will irrigate practically waterless but marvelously fertile lands as far south as Bakersfield, 160 miles away. Gravity will be beaten by a take-off far up the south abutment of the dam and a grade of only 6 inches per mile.

The dry bed of the San Joaquin below its bend must be filled. So Shasta Dam, 350 miles north, at the head of the Sacramento Valley, will release Sacramento River water from its 4,500,000 acre-foot hoard. Pumped out of the Sacramento just below the capital city, 10,000 cubic feet of water per second will shove its way, through natural sloughs and a short canal, across the sluggish currents of the Sacramento-San Joaquin Delta streams.

On the other side of the Delta, a small river will be deepened at the upper end so that it flows backward, drawing most of these "Delta Cross Channel" waters with it into a battery of six great pumps. These pumps, operated by giant 27,000-horse power motors, will lift the water 200 feet into the concrete-lined Delta-Mendota Canal, whose gentle grade of 3 inches to the mile, will carry it 120 miles down to the San Joaquin bend. Here it will empty into Mendota pool, a shallow reservoir from which it will be led all over the countryside formerly served by the San Joaquin.

On its way to the Delta pumps, Shasta water will casually fill up the small Contra Costa Canal. This 48 miles of concrete-lined waterway will serve 20,000 acres of farms, several municipalities, and many great factories along the shoreline of upper San Francisco Bay.

G. V. Gideon's photo with engineers' conception of how the trick is done.

Water rushing out of Shasta Dam will turn five 75,000 kilowatt generators there and three 25,000 kilowatters at Keswick dam—afterbay structure 7 miles downstream—to produce an average annual 1,500,000,000 kilowatt-hours which will supply electrical energy for the Cross Channel, Contra Costa and Delta-Mendota pumps, and lessen municipal and farm power costs throughout northern California. The dam controls floods in the winter. In the summer its valves open wide to deepen the river for navigation and give it enough force to drive out intrusive salt tides from the bay, thus protecting 36,000 fine Delta acres from saline poisoning.

Ultimately—in 25 years, perhaps in 50—if funds are made available, and the Bureau's plans materialize, every little foothill stream worth damming will have been dammed to put every useable drop of water to its fullest use. The Central Valley will be completely ringed by dams and power plants, and webbed with 1,500 miles of interconnected main canals, using water at one time from one river, at another time from another, depending on the season.

When the Central Valley project is fully developed there will be a firm water supply for all needy land now partly irrigated, and enough new water for 3,000,000 more acres—perhaps 30,000 new farms. And 8 billion kilowatt-hours of new power will have increased the present northern California supply by 40 percent.

What will vast amounts of new rich land, new low-cost power mean to the economy of the Central Valley? They ought to help make the valley the garden spot of the earth, filled with new prosperous farms, new industry, endless job and business opportunities. The myriad of lakes behind the dams will give every town in the valley a pleasant recreational area at its very doorstep. In brief, all the elements of the good life will be near at hand for 2,000,000 or more people. If they do not make good use of their opportunities, it will not be the fault of the Central Valley project!

The Man Behind the "GUN"

by Gene Nicolai

Region I, Coulee Dam, Wash.

AT LEFT, *mortar being applied pneumatically to a lateral on the 5,400-acre Pasco Unit of the Columbia Basin project in Eastern Washington. This rapidly moving operator manages to keep ahead of the finishing crew, background. Photo by F. B. Pomeroy, Region I.*

On a sagebrush-covered bench of the Columbia Basin project in eastern Washington the Bureau of Reclamation's long-range program in developing less costly canal lining methods is proceeding under a gun—a gun that discharges mortar and leaves a new canal in its wake.

Although still in the experimental stage on the Columbia Basin project, the use of pneumatically applied mortar on the first unit of the Nation's largest irrigation development is particularly significant because it may find extensive application in the thousands of miles of laterals yet to be built before the million-acre expanse can become productive.

The shooting of mortar by compressed air is not new in the industrial field, having been used for years in lining main entries of coal mines, and on many construction jobs. Mortar lining on some Bureau projects also dates back several years. It has been used quite extensively in the Southwest, particularly Arizona and California, but results are not sufficiently conclusive, as far as the Columbia Basin project is concerned, because of the wide variations in temperatures to which linings will be subjected in the Northwest. Winters of eastern Washington generally are longer and more severe than in the Southwest.

In the Pasco unit, the lining experiment also is noteworthy because the mortar is being applied directly to the freshly compacted earth embankments, and without the aid of reinforcing steel wire. This is a simplification of some of the earlier experimental studies. (See RECLAMATION ERA, August 1946.)

Low cost and durability are the chief objectives in the lining test. Only a small crew is required, and the men can be trained rapidly. The key man in the lining cycle is the "man behind the gun." His skill determines how rapidly the work proceeds.

On the Pasco unit, where the test mortar is being applied by J. A. Terteling & Sons, Inc., Boise, Idaho, the procedure follows a routine that appears as simple as spraying a field.

The lining routine begins after the canal has been excavated and shaped. A mobile unit, containing a mixer and compressor, is stationed alongside the cut. The gun operator, working from a movable platform just above the canal bottom, signals for service. A spray of mortar shoots from his gun, and the mixture adheres to the canal as he guides the nozzle along the unfinished section. A 2-inch thickness of mortar builds up rapidly.

Seven men comprise the mortaring crew. Two men operate the combination mixer and compressor; one man feeds cement and sand to the unit; four men work in the canal: The gun operator, his helper, a finisher, and a man who applies filler in expansion joints.

Bureau of Reclamation inspectors check the work. Examinations are made regularly to ascertain if the mortar has been built up to the proper thickness. Other tests are made of the mortar to find out whether it contains the correct materials and in proper proportions. Its composi-

tion is four parts sand to one part cement, by weight, plus necessary water.

The freshly applied mortar is quite stable and requires a minimum of finishing. One finisher, using a trowel and a long-handled brush, can keep apace with the gun operator.

Application of filler to expansion joints is equally simple. Known as "mastic filler," the asphaltic-base material also contains short-fibered asbestos, diatomaceous earth (according to Webster, a fine, variously colored earth sometimes called kieselguhr, used as a dope for dynamite, a polishing powder, etc.), and powdered limestone. It is delivered to the job in powdered form, is mixed speedily in a 5-gallon container by adding an asphaltic flux oil, and is applied with a calking gun.

As mentioned earlier, reinforcing steel wire is not employed in the test section at Pasco. It was, however, employed in a similar experiment recently on two sections of the Roza division of the Bureau's Yakima project, also in eastern Washington. The Roza experiment also differed in that no finisher followed the gun operator.

Further construction on the Pasco unit will find another experiment under way to cut canal-lining costs. Other sublaterals will be finished with bituminous material identical with that used in surfacing highways. In this test, soil sterilant will be applied to halt weed encroachment.

Chief Engineer Walker R. Young of the Bureau of Reclamation reported in the Engineering News-Record (February 6, 1947) that the Bureau's tests of low-cost lining of canals will lean heavily on the know-how of industry.

"Thousands of miles of irrigation canals in the western part of the United States fail to deliver a large proportion of the water turned into them at their intakes because of leakage from unlined sections," Mr. Young said. "To reduce these losses of valuable water, the Bureau of Reclamation is conducting a broad program aimed at the development of lower-cost canal linings. In this program the Bureau, recognizing the past performances of the construction industry in reducing costs and improving workmanship, appeals to the ingenuity of the contractor, the equipment manufacturer, and the materials produced for aid in developing satisfactory linings that can be installed at costs that are economically justified.

ABOVE, ***over-all "shot" of the job. In this photo the compressor serves the man with the gun, while the boys apply the finishing touches to the groove.*** **AT RIGHT,** ***closeup of the "finishers." Note man on platform spraying two-inch layer of mortar to freshly compacted earth.*** **BELOW,** ***worker with mastic filler plugging expansion joint after mortar has been applied to Pasco lateral. He does the job with ordinary calking gun. All photos by F. B. Pomeroy, Region I.***

"The long-felt need for lining irrigation canals is intensified today by the increased demand for irrigated land in the West and the growing necessities of conserving vital water supplies and of protecting productive lands from seepage. However, with the costs of lining canals by conventional methods and with orthodox materials now at levels that are prohibitive for many distribution systems, the Bureau is looking beyond the precedent of the familiar trapezoidal canal section with its concrete lining and has begun to explore the possibilities of radically different designs, materials, and construction methods," he added.

The Pasco test unit can be cited as a clear-cut example of departure from the traditional. And if the experiment is successful, then construction-cost estimates for laterals on the remainder of the project may drop, with resultant benefits to farmers.

Next Month—"Try-outs of Precast Canal Linings" by Field Engineer Van E. Nutley—an account of the experiments conducted on the Roza division of the Yakima project, Wash., for lining small canals with precast concrete blocks.

Getting Rid of a Bloomin' Nuisance

by Clayton L. Long,

Former Agronomist, Region I, Boise, Idaho

Weeds are going to take an awful beating in one little 20-acre section of the Pacific Northwest one of these days. They're going to be electrocuted, poisoned, sterilized, dug-up, cut-up, sprayed, trampled on, have their life history exposed, and, in general, be subjected to a thorough going over.

The 20-acre tract will constitute one of the two weed experiment stations involving irrigated agriculture being put in operation in the West for the first time to perfect the best way of putting an end to this "blomin' nuisance." The Bureau of Reclamation and the Bureau of Plant Industry, Department of Agriculture, are establishing the stations and many other agencies will help to conduct the research work.

One of the two stations will be situated on Hubbard Lake, a few miles south of the town of Meridian, on the Boise project in southwestern Idaho. Clearing and leveling of the land and other preparations were initiated in May.

A series of canals will be created in which water weeds will be encouraged to grow. The established weeds will then be treated with various concentrations of different chemicals and their effect upon the water weeds determined. Below the canals will be situated a series of plots seeded to farm crops. The water from the chemically treated canals will be used for irrigating these crops and the effect of the chemicals upon the crops determined.

Every agency involved in the weed problem is pitching in under a cooperative arrangement. Ada County is furnishing office and laboratory space, with water, heat, and light, in their building located at Meridian. The county is also making available the use of certain weed-fighting equipment and the advice and counsel of their county weed supervisor. The board of control of the Boise project is furnishing land and water to the Bureau of Plant Industry for the station and equipment and technical aid in leveling, grading, and laying out ditches.

The University of Idaho is furnishing the advice and counsel of its weed and other specialists in the weed control research and grass planting program for ditchbanks. Later the university may rent additional weed-infested lands for the work, if necessary. The Idaho Noxious Weed Association is giving its wholehearted moral support together with advice and guidance.

The Regional Office of the Bureau of Reclamation will supply technical aid and the advice of the Chief, Irrigation Operations Division, and the agronomist. They will also conduct large-scale trials of promising methods of control and eradication as they are developed by the weed station.

Weeds account for more than 50 percent of water users' losses from all pests. Moreover they increase the operation and maintenance costs on irrigation systems as well.

The Owyhee project (Oregon-Idaho) reported in 1945 that the cost of the removal of weeds constituted about 14.7 percent of the total cost for operation and maintenance. Removal of weeds as reported amounted to $35,710.38 on this project, which would average $62.76 per mile for all canals and laterals or about $0.47 per irrigable acre of land.

The need for a comprehensive research program for determining ways and means for combatting this most destructive and expensive pest on irrigation lands and water distribution systems has been apparent for some time. The research station under the active management of Jesse M. Hodgson, associate agronomist, has formulated a program which will serve as a logical beginning of the experiments.

A thorough test will be made of the electrovator, which electrocutes weeds, to determine its effectiveness on several of the most noxious land weeds on different soils with different moisture content.

The most effective time and concentration of 2,4–D for the control and eradication of willows will be determined. The effectiveness of 2,4–D in controlling weeds in newly seeded grasses and its effect upon the grasses at different time periods following the germination of the seed, and the effect of this chemical at different concentrations in irrigation water upon crop seeds, will also be studied. Tests will be conducted with combinations of 2,4–D, tillage (shoot cutting), and cropping to determine their effectiveness in weed control.

The research group will also make life history studies of the Potamogetons (pondweeds) and other aquatic weeds, conduct root reserve studies of willows, cattails, Potamogetons, and other water weeds, and determine the effectiveness of chemical treatment for water weed control in dry irrigation ditches. The use of methoxone and other selective herbicides against pre-emergence weeds will be tested.

As the research program develops and matures, and the Bureau follows through with larger trials in the field to adapt the station's findings to field conditions, a general improvement in the economy and effectiveness of the weed control program will, no doubt, result and the Bureau's partner, the water user, will be more confident in his program for control of weeds on his farm. •

Photo by Philip Merritt, Region I

ELECTROCUTION—*The Electrovator is used to give weeds the "finishing touch."*

Photo by Stanley Rasmussen, Region I

ELOCUTION—*The author cross-examines the "criminal" as a group of Boise farmers weigh the evidence.*

Photo by Ben D. Glaha, Region II

Almost 400 tons of baled hay in these stacks, Minidoka project farm, Idaho, is typical of new record.

Reclamation's Crop Record

For the first time in the 45-year history of the Bureau of Reclamation, the value of crops produced on lands served by project systems in 1946 exceeded half a billion dollars. Compared with 1945 returns, 40 projects showed an increase in total crop values, and 6 projects showed a decrease. Furthermore, the number of projects supplied with irrigation water increased from 46 to 54; the acreage capable of being served a full irrigation supply increased from 2,437,046 to 2,486,793 acres; the area supplied supplemental water and other special contractors increased from 2,576,082 to 2,621,838 acres; and the population on project farms and in cities, towns, and villages dependent on Federal irrigation systems increased from 1,328,411 to 1,398,856.

The benefits derived from the Federal reclamation program are here summarized, based on a comprehensive census of project achievements taken at the close of the year.

For the Nation as a whole, the total output of crops in 1946 was the greatest in history. High yields were primarily responsible, supported by a growing season more favorable than usual. The records for the Federal reclamation projects indicate corresponding excellent production, both in quantity and quality of the crops harvested.

High prices prevailed for farm produce in 1946 and at the same time some of the wartime difficulties as to machinery and labor shortages were alleviated. Farm wage rates reached a record high in the fall, but more labor was available than in the preceding year. The gross values of crops reported for the reclamation projects, therefore, were affected generally by high prices and high yields. This resulted in an upward trend in values, as compared with 1945, and in some cases on individual projects, a sharp increase in the crop values over the preceding year. Increases in crop values generally were accompanied by increases in the cost of production.

The accompanying charts and tabulations show the total achievements under the crop program on Reclamation projects as reported for the calendar year 1946. Crops having a total gross value of $530,623,945 were produced on 4,396,581 acres in cultivation. Of this acreage, 1,990,621 acres received a full supply of water from works constructed by the Bureau of Reclamation, and 2,405,960 acres received a partial or supplemental water supply due to Bureau activities. The average gross value of all crops was $120.69 per acre, as compared to $103.72 in 1945. For lands receiving a full supply of water from the Bureau, the range of gross value was $17.88 to $747.60 per acre. For lands receiving supplemental water from Bureau-constructed systems, the range of value was $16.05 to $245.56 per acre. A wide diversity of crops grown, varying stages of land development, and different types of farming activities caused these variations in returns. Related also is the additional income received from the sale of livestock and livestock products which is not reported.

(continued on page 220)

Reclamation's 1946 Harvest

These 54 Irrigation Projects Produced→

Breaks 45-Year Record

Crops Worth Over One-half Billion Dollars

GRAND TOTAL
$530,623,945

CROP RECORD

(continued from page 217)

The 1946 summaries include census reports for 54 projects. On 16 of these projects there were lands outside the regular project areas which received surplus project water under the provisions of the act of February 21, 1911 (36 Stat. 925), known as the Warren Act. In a special category, also, is the Imperial irrigation district, which is included in the total of 54, with 400,000 acres irrigated with water which flowed from the Colorado River through the All-American Canal into Imperial Valley.

The total irrigable land for which the Bureau of Reclamation in 1946 was prepared to supply water was 5,150,831 acres. A total of 4,321,969 acres was actually irrigated, and 4,396,581 acres were in cultivation. The net acreage in cultivation includes some land lying fallow for soil building purposes and not actually irrigated during the year, as well as miscellaneous small tracts from which income was received but to which water was not applied in 1946. Compared with 1945, the acreage increases were as follows:

	1945	1946	Increase	Percent of increase
	Acres	*Acres*	*Acres*	
Total irrigable area	5,030,336	5,150,831	120,495	2.39
Total irrigated area	4,162,588	4,321,969	159,381	3.82
Total net area in cultivation	4,195,732	4,396,581	200,849	4.78

The project area actually irrigated in 1946 (or 4,321,969 acres) was 81.5 percent of the total project irrigable area, or 5,150,831 acres. An analysis of the use of the project land not irrigated shows the following percentages, which are approximately the same as in previous years:

Area actually irrigated	81.5
Land set aside for farm buildings, rights-of-way, and roads	4.0
Class 5 land temporarily suspended from the paying classes and not in cultivation	4.1
Land that was dry farmed	1.6
Land that was idle	8.8
Total irrigable area	100.0

The irrigable lands have been summarized, with a break-down as to the area presently irrigable and additional lands to be served. Furthermore, the acreage has been segregated as to public lands, land in private ownership, and State and Indian lands. Totals are as follows:

Area irrigable in 1946	Acres
Public lands:	
Entered	665,484
Open	2,089
Withdrawn	56,284
Private lands:	
Railroad, unsold	16,851
Other	4,198,637
State lands, unsold	13,650
Indian lands	24,899
Class 5 lands, all categories	172,937
Total	5,150,831

Additional area to be served	Acres
Total irrigable area, end of 1946	5,150,831
Additional land expected to be served irrigation water during 1947:	
Public	45,884
Private	107,449
Total	153,333
Additional irrigable land, to be served irrigation water 1948 or thereafter	9,667,176
Total ultimate irrigable acreage in authorized projects	14,971,340

Crop Production

The outstanding yields of the 1946 harvest were reflected in the summary of tonnage of food and forage crops. There were 14,439,131 tons reported for reclamation projects in 1946, compared with 11,814,337 tons produced in 1945, an increase of 2,624,794 tons, or 22.2 percent. The increase in acreage harvested was only 4.78 percent, indicating that the higher yield per acre was primarily responsible for the increase in tonnage. The most notable increases were in grains, seed crops, beans, truck, and sugar beets.

Detailed census reports were received for 55.8 percent of the total acreage, as the Warren Act contractors, for the most part, submit summary reports of estimated results only. The diagram on this page shows how the land for which detailed reports were received was utilized.

Crop Values

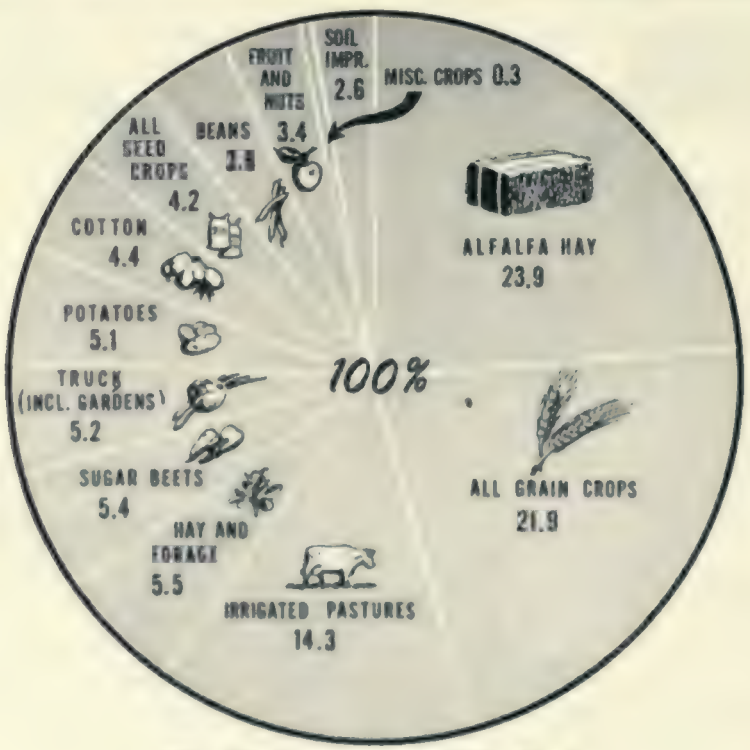
The total gross crop value for all project areas in 1946 was $530,623,945, or $95,439,550 more than in 1945. This was an increase of 21.9 percent. Prices were high, yields per acre were above previous averages, and new project areas were in cultivation and reported in 1946 for the first time, all contributing to this outstanding increase in gross value. The total gross value is shown on the chart on page 219.

The benefit payments for 1946 crops include Government payments for sugar beets, cotton, soil conservation practices, as well as sugar factory bonus payments which are based on sugar content of the beets. These payments, altogether, amounted to 2.2 percent of the gross income reported.

Miscellaneous Crops

Summaries have been made in connection with the 1946 reports, for the first time, as to some of the more important miscellaneous or specialty crops. In some instances these individual crops account for large segments of project income and are a vital contribution to prosperity in a region.

Crop	Acreage	Production	Gross value
Fruits and nuts:		*Pounds*	
Apricots	3,070	25,068,496	$1,280,795
Cherries	3,982	32,052,259	4,067,529
Grapes	3,896	20,648,906	938,188
Pecans	5,157	2,132,470	823,836
Truck:		*Bushels*	
Asparagus	4,576	854,877	1,767,922
Cantaloupes	18,470	3,072,145	5,535,270
Carrots	6,987	1,942,880	2,343,417
Sweet corn	7,279	1,412,615	558,588
Lettuce	48,422	14,014,872	10,365,668
Melons	5,573	1,402,068	1,346,671
Tomatoes	9,766	3,002,553	2,190,699
Peas	12,456	659,328	1,158,242
Seed:			
Peas	16,291	323,772	1,122,461
Beans	8,398	172,592	866,446
Sweet corn	5,868	261,357	1,011,580
Flax	19,783	445,932	1,661,836
Sugar beets	3,039	449,768	1,117,149
Miscellaneous:		*Pounds*	
Hops	4,240	6,816,282	4,623,859
Mint oil	1,119	55,576	336,846
Nursery	854		538,633



How Reclamation Land Was Used

Livestock

The value of livestock on reclamation farms on November 1, 1946, amounted to $74,078,198, or an increase of more than $5,000,000 as compared with the same date in 1945. This amounted to an average value of $1,140 per farm reported. The inventory does not cover the Warren Act contractors.

The summary indicates there were 520,688 cattle valued at $49,718,146, and 1,011,787 sheep valued at $10,864,849. This inventory does not measure the income that is derived through the year by reclamation farmers from the sale of livestock and livestock products.

Area Development

A total of 88,657 irrigated farms was reported in 1946, including those areas served a partial or full water supply under the Warren Act. However, this total did not include the Truckee Storage, Provo River, and Weber River projects for which no reports were received. In 1945 these three projects had 5,530 irrigated farms.

The population for the 88,657 project farms reported totaled 331,435. The population of towns on or adjacent to the projects reported was 1,067,421. The census at the close of 1946 showed 1,057 schools, 1,668 churches, and 149 banks serving the project farms and towns.

Water Deliveries

Information on water diversions, losses in irrigation systems, and the total delivered to farms has been summarized for 36 projects or divisions of projects in 1946. On the basis of these reports a total net supply of 14,551,659 acre-feet was diverted; 5,633,289 acre-feet were lost, principally through seepage from the main canals and laterals; and 8,892,882 acre-feet, or 61.1 percent, were delivered to farms.

Operation and Maintenance

In 1946, revenues to carry on operation and maintenance work on 19 projects, operated in whole or in part by the Bureau, amounted to $2,311,841.67. The total operating expenses totaled $2,254,063.37, leaving an excess of revenues over expenses for the calendar year 1946 of $57,778.30. The largest item of expense was for operation and maintenance of the irrigation canal and lateral systems, and the principal source of revenues was from operation and maintenance charges assessed and paid by the water users. Both revenues and expenses exceeded those recorded for the calendar year 1945.

●

The above article was extracted from "Data on Acreages, Crops, Water Deliveries, Costs, Revenues, and Settlement," recent report of the United States Department of the Interior, Bureau of Reclamation, Branch of Operation and Maintenance.

WATER REPORT

This year, most of the Bureau of Reclamation projects, except in the drought-stricken Southwest, have had sufficient irrigation water to mature their crops profitably, and still leave ample hold-over storage for future operations. In the drought-stricken Arizona and New Mexico projects, the situation is critical. Reserves are below normal in all reservoirs of those projects and are near record lows on several. During the month of August, stream flow in the West increased generally, and some of the streams in Arizona and New Mexico showed considerable improvement over the preceding months.

Ground water and stream flow measurements for August, made by the Geological Survey of the Department of the Interior, show a range of from 2,300 percent of normal in southeastern Oklahoma to 0 in south central South Dakota and southern California.

Surface run-off and stream flow were below normal in southern California, Nevada, New Mexico, South Dakota, Nebraska, Kansas, Oklahoma, except for the southeastern corner, and central and western Texas.

Stream flows and well-levels are plotted on the Geological Survey map reproduced below. Small circles with a line drawn from them like the hour hand of a clock, indicate the measurements of well-levels. The hour hand at 12 o'clock means that the wells in that area are full of water. The hand at 3 o'clock denotes normal levels, while low levels are shown by the hand at 6 o'clock. Where wells are heavily pumped, the indicating circle is solid black. The usually heavy August stream flows are shown by cross-hatching, whereas dotted areas indicate unusually low stream flow. The figures represent percentages of normal August stream flow. Thus 110 appearing on the map means that streams in that vicinity were running at 110 percent of August average or 10 percent above normal. The figure 51 on the other hand, denotes that streams are at only 51 percent of normal or 49 percent below median August stream flow.

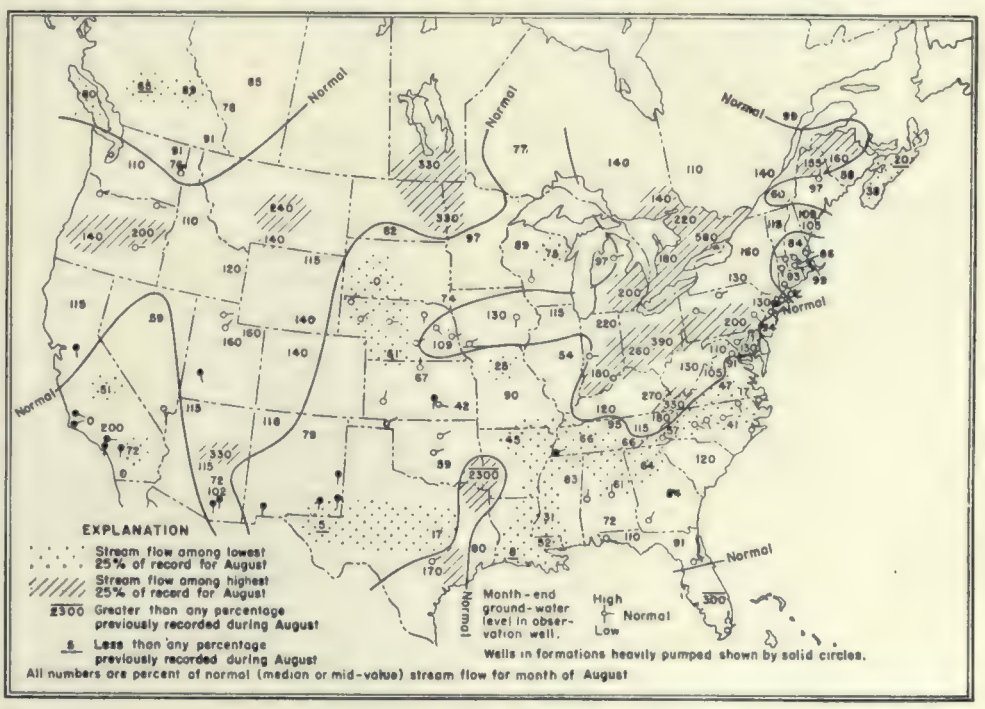
Although run-off in Arizona and New Mexico showed considerable improvement over preceding months, the situation still remains critical. Storage reserves for irrigation and power are generally much below last year.

In New Mexico, the run-off of the Rio Grande increased during the month of August to above the 30-year August average. However, the project's reservoirs contained less than one-fifth of their total active capacities, the lowest August since 1918. In view of the critical condition of the project's reserves, no releases from storage are planned during the fall and winter.

In central Arizona, drought conditions have been so severe that a serious shortage of water for both irrigation and power has resulted. At the end of August the reservoirs of the Salt River project held only about 13 percent of their total active capacity. The 1,398,400 acre-foot Roosevelt Reservoir was empty, and had been empty, or nearly so, since June. While the

(continued on page 228)

Stream Flow and Ground Water in Relation to Normal—August 1947


Normal
EXPLANATION
Stream flow among lowest 25% of record for August
Stream flow among highest 25% of record for August
Greater than any percentage previously recorded during August
Less than any percentage previously recorded during August
All numbers are percent of normal (median or mid-value) stream flow for month of August
Month-end ground-water level in observation well.
High
Normal
Low
Wells in formations heavily pumped shown by solid circles.

Map through the courtesy of the Geological Survey

Water Stored in Reclamation Reservoirs

Location	Project and State	Reservoir	Storage (in acre-feet)		
			Active capacity*	Aug. 31, 1946	Aug. 31, 1947
Region 1	Baker, Oreg	Thief Valley	17,400	6,600	5,220
	Bitterroot, Mont	Lake Como	34,700	12,900	17,600
	Boise, Idaho	Anderson Ranch	464,200	2,100	2,000
		Arrowrock	286,600	134,000	164,500
		Deadwood	161,900	123,900	93,900
		Deer Flat	169,000	41,600	35,100
	Burnt River, Oreg	Unity	24,600	8,230	4,600
	Columbia Basin, Wash	F. D. Roosevelt	5,220,000	5,220,000	5,196,000
	Deschutes, Oreg	Crane Prairie	50,000	40,000	20,000
		Wickiup	187,000	43,500	61,000
	Minidoka, Idaho-Wyo	American Falls	1,700,000	818,800	834,300
		Jackson Lake	847,000	459,900	589,100
		Lake Walcott	95,200	97,100	95,400
		Grassy Lake	15,200	12,100	15,100
		Island Park	127,300	61,400	95,800
	Okanogan, Wash	Conconnully	13,000	6,000	3,800
		Salmon Lake	10,500	10,000	5,400
	Owyhee, Oreg.-Idaho	Owyhee	715,000	454,900	320,900
	Umatilla, Oreg	Cold Springs	50,000	10,900	4,800
		McKay	73,800	26,500	16,600
	Vale, Oreg	Agency Valley	60,000	22,300	23,900
		Warm Springs	170,000	104,800	35,900
	Yakima, Wash	Bumping Lake	33,800	11,100	12,000
		Clear Creek	5,300	5,300	5,300
		Cle Elum	435,700	277,700	198,300
		Kachess	239,000	165,400	174,600
		Keechelus	153,000	109,200	58,900
		Tieton	197,000	160,000	130,500
Region 2	Central Valley, Calif.	Millerton Lake	503,100	235,400	125,100
		Shasta	4,389,100	2,507,100	2,303,100
	Klamath, Calif.-Oreg	Clear Lake	437,500	220,400	154,200
		Gerber	94,300	31,300	16,700
		Upper Klamath Lake	524,800	212,000	189,600
	Orland, Calif.	East Park	47,900	25,400	8,400
		Stony Gorge	50,000	4,900	10,900
Region 3	Boulder Canyon, Ariz.-Nev	Lake Mead	27,935,000	19,454,000	21,901,000
	Parker, Ariz.-Calif.	Havasu	688,000	665,500	658,300
	Salt River, Ariz.	Bartlett	179,500	14,200	10,400
		Horse Mesa	245,100	229,900	176,900
		Horseshoe	67,000	8,400	11,400
		Mormon Flat	57,850	54,500	36,800
		Roosevelt	1,398,400	38,100	0
		Stewart Mountain	69,800	43,100	34,500
Region 4	Fruit Growers, Colo.	Fruit Growers	4,500	700	1,400
	Humboldt, Nev.	Rye Patch	179,000	153,900	119,000
	Moon Lake, Utah	Moon Lake	35,800	2,100	18,900
		Midview	5,800	4,300	5,400
	Newlands, Calif.-Nev.	Lahontan	273,600	154,200	93,300
		Lake Tahoe	732,000	614,400	456,000
	Newton, Utah	Newton	5,300	2,000	2,500
	Ogden River, Utah	Pine View	44,200	14,500	18,600
	Pine River, Colo.	Vallecito	126,300	58,100	97,600
	Provo River, Utah	Deer Creek	146,800	119,900	130,100
	Scofield, Utah	Scofield	65,800	4,100	18,400
	Strawberry Valley, Utah	Strawberry	270,000	111,500	115,700
	Truckee River Storage, Calif.-Nev.	Boca	40,900	30,400	12,600
	Uncompahgre, Colo.	Taylor Park	106,200	90,100	106,700
Region 5	W. C. Austin, Okla.	Altus	140,000	9,700	65,800
	Carlsbad, N. Mex.	Alamogordo	128,300	24,405	9,300
		Avalon	6,000	945	500
	Rio Grande, N. Mex.-Tex.	Caballo	345,900	25,700	36,200
		Elephant Butte	1,830,300	680,700	324,800
	Tucumcari, N. Mex.	Conchas	300,000	238,700	269,900
Region 6	Belle Fourche, S. Dak.	Belle Fourche	177,500	126,300	120,700
	Milk River, Mont.	Fresno	127,200	43,900	69,000
		Nelson	66,800	24,500	44,800
		Sherburne Lakes	66,100	27,600	25,200
	Rapid Valley, S. Dak.	Deerfield	15,000	5,700	12,400
	Riverton, Wyo.	Bull Lake	152,000	103,700	122,000
		Pilot Butte	31,500	6,200	7,900
	Shoshone, Wyo.	Buffalo Bill	456,600	400,400	434,900
	Sun River, Mont.	Gibson	105,000	41,700	39,700
		Pishkun	32,050	21,000	25,400
		Willow Creek	32,400	12,800	14,600
Region 7	Colorado-Big Thompson, Colo.	Green Mountain	146,900	145,200	145,300
	Kendrick, Wyo.	Alcova	190,500	128,400	185,200
		Seminoe	970,000	555,700	867,200
	Mirage Flats, Nebr.	Box Butte	31,700	6,000	20,400
	North Platte, Nebr.-Wyo.	Guernsey	41,050	13,000	4,900
		Lake Alice	11,000	1,500	700
		Lake Minatare	57,000	11,100	25,600
		Pathfinder	1,040,500	9,200	195,900

*Available for irrigation

Electricity and its FARM CHORES

by
Creighton W. Bicket

Engineer, Branch of Power Utilization
Region I, Boise, Idaho

". . . There couldn't possibly be a market for Coulee power."

Before the mammoth Grand Coulee Dam was constructed, and later as it neared completion, doubting Thomases were raising their voices in protest against the enormous electrical installation contemplated. Said they: Since the population growth of Spokane, Seattle, Portland, and other major towns ranged between ½ and 1 percent per year, there could not possibly be a market for Coulee's power for years to come.

During World War II, the tremendous capacity of Grand Coulee generators proved a major cog in the prosecution of the war, making possible the production of aluminum, magnesium, and the atomic bomb at Hanford, Wash. But still the doubters ridiculed. They were sure that once the war was over there would be a large surplus of electric energy in the Pacific Northwest.

Today, instead of a surplus, there is a shortage. The region is figuratively crying for the installation of additional generators at Grand Coulee Dam and for additional dams and powerhouses. Some structures, fortunately, have been approved for early construction.

Basically, there are three major reasons for the power shortage in the Northwest. They are: (1) industrialization of the area, principally in the field of light metals, (2) population influx, and (3) greater use of electricity per customer. It is the latter—greater use per customer—the farm customer, to be specific, who is the subject of this article.

The consumption of electricity on farms in the United States has been growing constantly. In 1923 the average yearly consumption on the farm was 300 kilowatt-hours. As Grand Coulee neared completion, this total had increased 3½ times. The 1946 farm average in the reclamation area was nearly 1,500 kilowatt-hours.

The Pacific Northwest is a pace-setter in use of electricity on the farm. Its consumption is about double the average for the Western States.

Mr. Average Farmer in the region is wisely taking advantage of the low electric rates made possible by Coulee and other dams. He is constantly raising his standard of living, taking the drudgery out of many tasks, and making for himself a richer, fuller life.

A wide field for the use of electric energy is open to farm people in all parts of the West, if it can be made available at reasonable rates. The potentialities are almost unlimited for steadily growing consumption of power and a continued lightening of the work load on our farms and in our farm homes. Here are some of the present and possible future uses.

Household Use

The household use of electricity in rural areas is substantially the same as that in urban centers, except that a pressure water system is necessary before electricity can be put to some other uses. The pressure system makes available running water for drinking and cooking, and emergencies like fighting fires. Installation of the electric hot water heater and the electric range generally completes the more permanent, heavy duty, installations for the house.

The all-electric farm residence likewise will have the radio, vacuum cleaner, refrigerator, washing machine, sewing machine, iron, and a host of other miscellaneous appliances. Of course, provision must be made for adequate lighting in the house and in the yard, in the barn and in the milk house. For those troubled with seepage of water into the basement, a sump pump will undoubtedly help the problem. As conditions permit, many will equip their homes with an electric dishwasher, garbage disposal unit, and electric blanket. And homes may be heated with the new "refrigerator-in-reverse." On many farms the freeze-box, to store meat, fruits, and berries, is considered nearly indispensable.

The introduction of electric lighting into cow barns is said to nearly pay for itself due to less spilling of milk. Ultraviolet rays from electric lamps are being used on cows to produce better milk. Electrically driven animal groomers clean the loose hair and dirt from the udder and flanks of a cow, thus assuring cleaner milk.

Heating of the cow's drinking water is said to increase the yearly average milk production by 5 to 15 percent, the greatest increase being in the colder climates. A higher quality of milk may be maintained by cooling it from 98° F. to 60° F. within an hour and subsequently storing it at 45° F. or below.

Other uses of electricity for dairying include electric milkers, pasteurizers, dairy hot water heaters, germicidal sterilizers for utensils, bottle washers, ventilating units for dairy barn, barn cleaners, electric fly screens, insect sprayers, churns, slippers, separators, and feed grinders and mixers.

Power can save farmers considerable time and effort in handling silage materials, besides giving a better quality of feed. Ensilage is said to be sour or sweet depending upon whether it is made below or above approximately 117° F. Experiments show that it may possibly be worth while to heat the fodder artificially by passing an electric current through the silo. Silage handling equipment includes the silo filler, unloader, and ensilage cutter.

Many farmers have eliminated weather risk at haying time by installing hay driers in their barn, where all curing beyond the first four hours in the sun takes place. Hay cured in this manner is reported positively superior to the completely sun-cured product. Moreover, electric hay driers give the next crops more than a week's growing start. Other forage handling uses for electricity include balers, shredders, and grain grinders.

Perhaps one of the earliest applications of electricity to poultry was that of using

artificial lighting to increase egg production. Annually, artificial lighting does not increase production, but the benefit accrues from heavier production at those times when prices are highest. Production during light laying periods has been increased 10 to 30 percent. For maximum effectiveness a 15-minute dimming period is given to provide "dusk," which provides the chickens sufficient time to "go to roost." Clocks are available which turn the lights on and off at the proper time.

Egg production may also be increased by electrically warming the drinking water for the chickens. In below freezing temperatures, chickens drink about 25 percent more water if heated, and in above freezing temperatures about 5 percent more. The extra water consumption increases their appetites and results in greater egg production. Egg production may be increased in summer by providing coolers for the hen house.

Ultraviolet light in 10-minute doses, morning and evening from December to March, is said to speed development of chickens and produce more fertile eggs. Ultraviolet light used continually helps prevent the spreading of colds throughout the flock. Other equipment, using electricity in connection with poultry, includes brooders, incubators, heaters, ventilating equipment, electrically operated dropping boards, poultry pickers, and egg cleaners.

Crop Production

Electric plowing, in which the ground is tilled by a plow suspended from motor driven cables, is practiced in Europe. This method is generally used on larger farms, and done by contract. Usual rate of tillage is one-third to 1 acre per hour, with an average of 5 acres per day. Some large plows, however, will handle up to 30 acres per day. In contrast to plowing by tractor, with electric plowing there is no packing of soil. While one might think a large maze of wires would be required, such is not the case, since the electric plow can operate anywhere within a quarter of a mile from its source of supply through long extension cords.

Electric power for pumping is important on farms. Orchardists, lettuce growers, and other types of farmers, are making more and more use of the pressure sprinkling systems. These are of either the overhead or surface variety. With the ultimate of installations, time clocks, together with electrically operated valves, enable one to irrigate in the cool of the night or very early morning without the accompanying loss of sleep. One lift-type installation in the Pacific Northwest contemplates the use of clock-operated electrical valves to provide water at the desired times, thus saving labor costs.

Some experimentation is being carried out to determine the effect of electricity on plant growth. Tests indicate that the growth of plants is stimulated by a network of overhead wires, kept at a potential of 25,000 to 50,000 volts. By using the network up to one-fourth of the time during the early stages of growth of certain cereals, an increase in yield of up to 20 percent has been realized. Wheat, for example, has been entirely grown to maturity in 3 months by the use of electric light, the grain being put into water along with the necessary nutrients. Many more experiments will have to be made before the relative overall benefits of such methods can be definitely established. Since the voltages used are dangerously high, the development and

Photo by Stanley Rasmussen, Region 1

Once-revolutionary milking machine—today commonplace—is one of farmer James Allen's many electrical appliances.

projection of such methods must be left to properly equipped research organizations.

Insects are being trapped (including apple bud moths and coddling moths) by means of an electric lamp, of about 100 watts, suspended over a pan partly filled with oil, or a pan of oil-covered water. Electric lights of specific colors may be used to attract pests of different sorts in orchards and gardens.

Also worthy of mention are the experiments with electricity for killing weeds. Here again, high voltages are required, so the development of such processes will, of necessity, be left to research organizations.

The all-electric farm will have an electrically powered sprayer to cope with spraying problems.

Crop Processing

The electric threshing machine is coming into prominence. The chief merit lies in the greater amount of grain (5 percent more) reportedly obtainable due to the steady speed of the motors. Other crop processing equipment includes grain elevators, corn shellers, corn shredders, grain seed cleaners, and straw cutters.

Cold storage for fruits, vegetables, and berries at the proper temperature enables farmers to hold their produce until the price is right. Experiments seem to indicate that a very high frequency radio wave has a preserving effect upon produce, and may therefore some day be employed to achieve the same results.

Related uses for electricity in crop processing include dehydration of fruits, vegetables, hops, nuts, etc., and cider mills.

Early Gardens

To provide an early start for vegetables or flowers, soil-heating cables are now being widely used. These consume, on an average, only 1 kilowatt-hour per day for each square foot of hotbed heated.

Some people are now putting a greenhouse in their basements. In this way, with the right application of electricity, the proper "length of day," the proper amount of heat, and the proper amount of infra-red and ultra-violet rays may be provided. Authorities, however, differ as to the degree of benefits of ultra-violet rays on some types of plant life. Experiments show that electric light in greenhouses has an accelerating effect upon the germination of seeds and hastens the growth of certain vegetables, the effect depending somewhat upon the color of the light.

Very intensive light on budding plants brings them quickly into bloom, and it is said that seedlings subjected to very strong light will not wilt.

In some places sterilization of soil is being practiced, to rid the soil of fungi and pests.

In the garden, too, the ultimate development might be time-governed, electrically operated valves for controlling irrigation water. A device has been perfected which will turn on the valve according to the dryness of the earth instead of by clock. This must be used, however, in conjunction with a timer or be turned off by hand, since no provision is made to shut off the water according to the saturation of the soil.

Miscellaneous Farm Uses

Electricity might possibly be used on the farm for branding irons, meat processing equipment, clippers, livestock sprayers, paint sprayers, sheep shears, electric fences, tool grinders, wood saws, concrete mixers, and lawn mowers. Ultra-violet light used in pig brooders is said to be of considerable help in preventing rickets.

Large Bureau of Reclamation hydroelectric plants, such as Grand Coulee, are enabling the farmer to use more and more and more power for a smaller and smaller cost per kilowatt-hour. Research is constantly developing new applications to make farm tasks easier and to enable the farmer to realize a higher net profit. Possibilities are unlimited. Day by day more power is sent to the farm. ●

Tumbling Tumbleweeds

by

William H. Mercer

Weed Control Specialist, Region V, Amarillo, Tex.

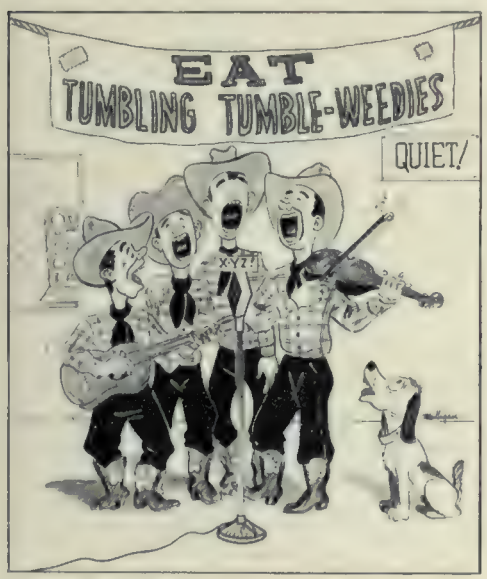
When the voice of a "Maitre de Cowboy Krooners" bursts through the radio of a western ranch or farm house to announce that the next number to be rendered by the quartet is entitled, "The Tumbleweed Song," you can bet your last irrigation ditch that listeners would like to stuff a five-string banjo down the collective throats of the singers.

The less western ranchers and farmers hear about tumbleweeds is all for the best, unless it should be a new wrinkle for eradicating them from fields and pastures.

The word "tumbleweed" may apply to any one of several itinerant weeds which are equipped by Nature to distribute their progeny over the landscape when propelled by wind power. The genuine tumbleweed, however, is the Russian Thistle, which holds all world records for long distance, high speed, broad jump, high hurdle, wide-sweep locomotion. It travels farther, faster, and in wider circles than any other weed on earth.

Each fall the Russian Thistles (tumbling tumbleweeds), which grow along highways and in fields and pastures, get the urge to go places and see things. Away they go, first one way and then another, all according to which way the wind blows.

The Russian Thistle began its gyrations and tumbling exercises on the Steppes of Siberia where it impoverished and crowded out multitudes of farmers before it started its round-the-world tour. Since leaving Siberia, its travels make the journeys of Genghis Khan appear as insignificant as a Sunday School excursion to the city park.



From Siberia the weed gained entrance into South Dakota at a time when neither plant nor human immigrants were required to have inspection passports or character recommendations. In the years since it first slipped into this country in 1874, mixed with seeds of grain, the weed has "naturalized" itself in practically every one of the States, in most Canadian provinces, and in Mexico.

A Russian farmer is said to have brought some crop seed with him when he migrated from Siberia to South Dakota. Mixed with the crop seed were seeds of the Russian Thistle. The farmer sold some of his first harvest of field seed to neighbors. The neighbors, who had never heard of Russian Thistles, planted the infested field crop seed without first cleaning it in a fanning mill. From that day to this, the offspring of the imported thistle have continued to plague the countryside, and the tumblers now exact a higher total tax from more farmers than any other weed.

No completely successful method to eradicate tumbleweeds has been developed to date and since the task appears to be hopeless, control plans are largely disregarded by a majority of farmers and ranchers. However, only recently some weapons for control have begun to be viewed with favor. It appears reasonable to hope that flame throwers and chemical formulas can and will be employed to an extent that tumbleweed populations will be reduced along highways, fence lines, ditch banks, on waste land, and around vacant lots in towns and cities.

Any successful control program, however, will require organized effort and cooperation between farmers and their town neighbors. In the beginning, the people must become more weed-conscious and gain a determination to study and apply every successful method and device developed up to the present time. Perhaps, in the near future, science can give them even better weapons than any now available.

●

Tall Tale by Mercer

Mercer is gaining wide recognition for his tall tales about weeds. Fact is, his extra-vocational talk has labeled him a foremost braggart in Texas, which is no small distinction. At last February's Western States Weed Control Conference in Portland, Oreg., Mr. Mercer, hard-pressed by other western weed men, had this tale to recall on the subject of Texas tumbleweeds:

"Knowing that a 25-mile travel limit would be an insult to any self-respecting Texas tumbleweed, my experiments started in the very tip of Texas. (Mr. Mercer's western colleagues had mentioned that some Texas tumbleweeds had been known to travel 25 miles in irrigation districts.)

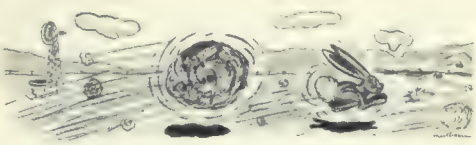
"Tumbleweeds, equipped with speedometers, were released in a stiff breeze between Port Isabel and Boca Chica. We timed them as they passed the Bureau's regional

Bill Mercer, admiring his certificate

office in Amarillo and succeeded in catching a few to read the speedometers. This proved difficult despite the fact that we used veteran cowpunchers who had experience in roping V-bombs directed over London in the late war. The elapsed time for the 900-mile run showed an average speed of 101.475 miles per hour, with short runs exceeding 151 miles per hour. The tumbleweeds were further shown to have planted 12,000 seeds per mile over the distance."

Other western weed specialists pulled in their yarns and quietly retired from the field. No western tumbleweed could match the Texas record. Mr. Mercer's tale knocked about among weed men over the Nation. And he was generally conceded to be a top-knocker among experts. Eventually the story reached John Randolph of Houston, Tex., who published a little book, "Texas Brags." So impressed was he by Mr. Mercer's account that Mr. Randolph wrote and asked permission to incorporate the story in a revised edition of the book.

Mr. Mercer was awarded the number one membership in the Solemn Order of Texas Braggarts, an organization reserved for true tellers of tall Texas tales. A fully embossed certificate was sent to Mr. Mercer at the Bureau of Reclamation office in Amarillo. It was complete, even with a seal of the Republic of Texas. Now Mr. Mercer, who started out simply as one of the world's great weed men, can "sit on the top rail" of any fence when he is telling a Texas brag. He is even bragging about being a Texan, having lived in the State off and on only since 1917 when he landed in San Antonio and was forced to write back home to North Dakota. "I have met the Texans and I am theirs."



Watermelon Time

by Elma Hill Neal

Songs have been sung and poems have been written about the beauties and fragrances and pure delights of apple blossom time, or the time when roses bloom or perhaps cider-making time. It is high time someone gave a little more credit to watermelon time.

The Englishman has his tea at 4 o'clock in the afternoon but the native Missourian reserved that hour for the soul-satisfying rite of cutting a ripe watermelon.

On a hot, humid afternoon when Grandpa came in from the timber, back of the barn, where he had been hewing out fence posts, he stopped by the cistern, quaffed a long drink, and with me by his side, started around the house for the cellar.

Lifting the trap door, we descended the steep steps. Grandpa slowly unlatched the thick inner door. There in the dark, damp insides, lined and floored with rock, were the fruits of the vine—watermelon and cantaloup. Almost tenderly, he picked up the long Klondike, whose zigzag stripes had been worn to a creamy yellow on the undersides, where it had wallowed in sandy soil through the long summer. Cautioned to be careful, I was allowed to carry a fragrant "mushmelon" that was golden plump and heavily ridged. Grandpa never plugged a melon. Years of experience, first gained, no doubt, in someone else's patch, enabled him, by scrutiny and by scarifying and through the deep hollow sound given off by an energetic thump, to tell the exact moment for plucking.

By the time we got safely around the house with our armloads, Grandma was there with butcher knife and salt box. The ripe melon popped and then was ripped its entire length with the first plunge of the knife. Jolted gently, it fell apart and lay in two dewy, luscious halves. To each of us was dealt a ruby wedge, rimmed with emerald and dotted with a mesh of black seeds. Without thought of cost or waste, we broke out the brittle hearts and threw the end pieces to the expectant Plymouth Rocks standing by.

Grandpa always had a melon patch somewhere on a sunny slope or rich piece of bottom land and in seasonable years it bore profusely. Along the last of August when the "dog days" were at their worst and the "snake doctors" hung flutteringly over the muddy ponds and the goldenrod grew gray and dusty by the roadsides, Grandpa would load up the wagon bed with some of the bigger ones and head for town. The trifling sum that he received for them was beside the point. It was size and quality of fruit that he wished to display to old neighbors and friends whom he chanced to meet in town or along the way. Each of them raised watermelons, too, of course, but it was a great subject for bragging and boasting.

Photo by Stanley Rasmussen, Region 1

Lou Obermeyer, Emmett, Idaho, thumps a likely specimen from his eight-acre melon patch.

Today, watermelons have a new place in the sun. Every State (and there are few out of the 48 who don't raise them) takes an inordinate pride in its melons. Watermelon raising is not the haphazard by-product of a piece of ground left over from other more important crops. It is a scientific bit of agriculture that meets a definite market need. There are fine points to be observed, shape, size, sweetness of flavor, texture of meat, thinness of rind. Melons have had their seeds bred out and a wilt resistance bred in. Their keeping qualities are an essential consideration. No longer is the watermelon season confined to August and September. Now from early June to late November, trucks are on the road, hurrying their sweet burdens to a never satisfied market.

Practically anybody can guess that there is a definite affinity between water and watermelons, and so, those raised on irrigated projects are the "patches" to be depended on commercially. It was on irrigated tracts that experiments could be made to improve varieties and build up new strains, for water, climate, and soil were constant. Poor old Grandpa had to take a disappointment every few years, for droughts were a known and feared factor in all of his agricultural operations. During such seasons, the creek bottoms dried and cracked open in criss-cross lines, the level of the water in the cistern dropped lower and lower, and the vines turned yellow and the baby melons withered on the stems.

In the old days, melons were seldom served at the table, but today, melons are served at any meal, from breakfast to midnight snack. Cut in fancy shapes, chilled melons and cantaloupes are combined with other fruits or served separately as cocktail, salad, or dessert. On airlines, high in the sky, or on streamliners, hurtling across the continent, melons are a favorite delicacy to add color and zip to the traveler's plate. A busy housewife finds a melon saves times and is often more welcome at the end of a meal than a heavier dessert. Reducing diets, in this era of fads and fancies, allow for melons because of their low caloric content.

And so, thanks to irrigation and modern transportation, that hallowed season known as watermelon time has been extended and intensified and given an atmosphere of permanence and dignity that it has so rightly deserved. •

Force Account Work Limited

Under a provision of the 1948 Interior Appropriation Act a limitation is placed on the amount of force account work (that done by hired labor). This will mean the virtual elimination of certain work for the fiscal year on projects where available funds are not sufficient to let additional contracts, or where normal contracts cannot be readily awarded.

Among the works to be affected by this limitation are the extensive irrigation construction and power development on the Columbia Basin project in the State of Washington, and the land levelling program on the Gila project in Arizona.

Yuma Homestead Opening Set

Twenty-eight family-sized farms on the Yuma project in Arizona were opened to homestead entry on September 9. This marks the seventh homestead opening by the Bureau of Reclamation within the past year and is expected to be followed in the near future by an announcement of the eighth—the opening of 4,941 acres of the Gila project, consisting of 54 farm units.

The Yuma area comprises 1,439 acres of land with farm units ranging in size from 28 to 82 acres. Veterans of World War II will have a 90-day preference period in which to file for homesteads (from the opening date, September 9, until December 8, 2 p. m., 1947).

For applications and additional details, interested persons should write to the Gila project office of the Bureau of Reclamation at Yuma, Ariz.; the Regional Director of the Bureau of Reclamation at Boulder City, Nev.; or the Washington office of the Bureau at Washington, D. C.

A settlement office to advise prospective settlers has been established at the Gila project at Yuma Army Air Base, 7 miles east of Yuma, Ariz.

Design Work Decentralized

In order to comply with appropriation limitations for the Denver engineering offices of the Bureau of Reclamation, and to relieve the overload of designing work scheduled for the fiscal year of 1948, 25 field design offices are being organized.

Heretofore, all of the Bureau's designing work was done in the Denver Office. While the Denver Office will continue to be the focal point for the design of dams and major structures, the field offices will be responsible for detailed designs on minor structures. Included in these will be the works appurtenant to dams, camps, roads, design of transmission lines and irrigation distribution systems. This procedure will place detailed design operation closer to the site of the many Reclamation projects. The basic technical control over these operations will continue to be exercised by the Chief Engineer, who will assign experts from his staff to head each office. In addition to this he will utilize a small group of traveling specialists to effect supervision and coordination.

While the financial limitation on the amount which can be spent for engineering services in Denver will provide 40 percent less than was spent during the fiscal year of 1947, the Bureau is committed to start construction on a greater number of dams this year than ever before. As a result the establishment of the field offices near work centers has become a mandate in order to meet this requirement.

The tentative locations of the design offices are as follows:

ARIZONA—Phoenix and Yuma.
CALIFORNIA—Friant Dam, Sacramento (transmission lines), Antioch, Redding, and Coachella Valley (site not determined).
COLORADO—Grand Junction and Estes Park.
IDAHO—Boise and Lewiston Orchards.
MONTANA—Great Falls and Miles City.
NEBRASKA—Indianola.
NEVADA—Boulder City.
NORTH DAKOTA—Bismarck.
OREGON—Klamath Falls.
SOUTH DAKOTA—Pierre.
TEXAS—Amarillo.
UTAH—Provo and Salt Lake.
WASHINGTON—Coulee Dam and Ephrata.
WYOMING—Heart Mountain and Casper.

NRA to Meet at Phoenix

The sixteenth Annual Convention of the National Reclamation Association will be held at Phoenix, Ariz., on October 29, 30, and 31. Among those who have been invited to attend are Secretary of the Interior J. A. Krug and Assistant Secretary William E. Warne, Secretary of Agriculture Clinton P. Anderson, Reclamation Commissioner Michael W. Straus, and other officials of the Interior Department, Bureau of Reclamation, Federal Power Commission, and the War Department. In addition, invitations have been extended to Senators Carl Hayden and Ernest W. McFarland of Arizona, Hugh Butler of Nebraska; Representative Ben Jensen of Iowa, and many others. The ERA will carry a full account of the meeting as soon as possible.

Markwell at Western State Engineers

Assistant Commissioner Kenneth Markwell represented the Bureau of Reclamation at the annual meeting of the Association of Western State Engineers held in Boise, Idaho, September 9–12. In addressing the meeting Mr. Markwell stressed the need for liberalization of Reclamation laws and their relation to the accelerated construction program planned by the Bureau over the coming 7-year period.

W. C. Austin Project Dedicated

In memory of the man who said, "The State should mark the way and bring her people to a point of understanding the value of controlling, using, and preserving the water as it falls upon our soil and as it passes into, through, and across the border," Oklahoma's first Reclamation project, the W. C. Austin, was dedicated on September 5 at the close of a three-day celebration.

The dedication was attended by many notables, including Secretary of the Interior J. A. Krug, Governor Roy J. Turner, Assistant Commissioner of Reclamation Wesley R. Nelson, Former Governor Robert S. Kerr, and Don McBride of the National Reclamation Association, all of whom were active participants in the dedication. Robert B. Harbison, former associate of the late Judge Austin, presided as chairman of the steering committee for the dedication. During the three days leading up to the celebration, the Ground Forces and the Army Air Corps of the United States Army presented a colorful show for the benefit of the thousands on hand.

President Joe B. Zinn of the Lugert-Altus irrigation district was cosponsor of the dedication and Harold Pease, president of the Altus Chamber of Commerce, extended full cooperation to make the occasion a success.

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Christmas Gift Suggestion:
A subscription to the RECLAMATION ERA

WATER REPORT

(Continued from page 221)

run-off has increased in some areas and served to alleviate the effects of the current drought, the ground and surface storage reserves are so depleted that many months of excess rainfall will be required to break the drought.

Thunderstorms and heavy rains occurred at several locations in the Colorado River Basin during August. The flow of the river was increased from 129 to 195 percent of normal. The active storage in Lake Mead, over 21,900,000 acre-feet, was the highest since 1945 and is sufficient to furnish adequately the irrigation needs of the Gila and Yuma projects and the Imperial Irrigation District.

In general, the outlook for a favorable hold-over storage is good for projects in the Columbia, Missouri, and Colorado River Basins. Heavy rains, flash floods, and early snow in the mountains have caused a run-off of normal or above in most of these basins. In some cases the daily run-off was near the spring flow. Soil moisture is in good to excellent condition for this time of year.

To compare the amount of water in storage in the Bureau of Reclamation reservoirs on the same date last year with this year's storage, see table on page 222. •

Uncle Sam Says

You, too, can be a harvester—and not once or twice a year but every month. What farmer—even the wheat men and women of Kansas and the Dakotas who at this moment are reaping the greatest harvest in history—would not prize a harvest every month. The harvest-a-month plan has popular name—the Bond-a-Month Plan. Begin today sowing financial seeds. For every $18.75 you plant during a month in the form of a United States Savings Bond $25 will sprout 10 years later.

U. S. Treasury Department

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Landownership Survey on Federal Reclamation Projects.*—Available upon request to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

2. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals,* by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939, 7-page mimeographed study with graphs.

3. *Questions and Answers About Forming an Irrigation District to Further Irrigation Under the Missouri Basin Development Project—Montana.*—Eight-page folder available upon request to the Regional Director, Bureau of Reclamation, Billings, Mont.

Available from the Superintendent of Documents, Washington 25, D. C.

1. *High-Pressure Reservoir Outlets,* by J. M. Gaylord and J. L. Savage—a report (1923) on Bureau installations compiled from correspondence, project histories, feature reports, technical papers, special reports prepared for this purpose, and from personal inspection of the installations described. Obtainable from the Superintendent of Documents.

2. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

3. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are: Problem 10, Pattern of Rural Settlement—25 cents, and Problem 28, Local Governmental Units—70 cents.

Problem 9 (Supplement), Standards and Levels of Living—20 cents.

Problem 14, Financial Aid for Settlers—25 cents.

Problem 23, Rural and Village Electrification—25 cents.

Problem 24, Agricultural Processing Industries—30 cents.

Problem 26, Recreational Development of Roosevelt Lake—75 cents.

4. *Central Valley Project Studies.*—Studies of diversified but interrelated problems affecting the wartime and long-term development of the Central Valley project in the State of California. Obtainable from the Superintendent of Documents. First released in the series are Problems 1–5, The War Program—45 cents.

5. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the east Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

6. *Columbia Basin Reclamation Project—South Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the south Columbia Basin irrigation district—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Appendix contains classifications and appraisal of lands excluded from the south Columbia Basin irrigation district. Fifty-five cents a copy.

Miscellaneous Publications

"Man as a Geological Force," by Paul Cohen, in *The Technology Review,* June 1947, page 469. Illustrated. According to the author, "At his current rate of engineering and agricultural operations, man is reshaping the earth's surface vastly more quickly than nature." (*The Technology Review* is a monthly publication of the Massachusetts Institute of Technology, Cambridge, Mass.)

Landscape Gardening for the Rural Community in the United States, a list of references on such subjects as lawns, rock gardens, roadside improvement, and so forth, compiled by Cora L. Feldkamp, Library, United States Department of Agriculture. 46-page mimeographed Library List No. 35, April 1947. This compilation contains author and subject indexes.

"Veterans May Get Preference in Coulee Area," by J. W. Granberg, in *Evergreen,* May 1947, page 10. Illustrated. Concerning preference of World War II veterans in acquiring family-size farms on the Bureau of Reclamation's Columbia Basin project (Wash.). Goodrich W. Lineweaver, Director, Bureau's Branch of Operation and Maintenance, has commented, "Settlement opportunities for veterans while they are young and vigorous is our major goal. We want to give them a chance to carve their future out of these fertile lands, go into the business or professions that will be made possible, and participate fully in the establishment of a new empire." (*Evergreen* is published monthly by Wilbur J. Granberg, Seattle, Wash.)

U. S. GOVERNMENT PRINTING OFFICE: 1947

NOTES FOR CONTRACTORS

CONTRACTS AWARDED DURING AUGUST 1947

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1768	Rio Grande, N. Mex.-Tex.	Aug. 8	Electrical equipment for Socorro substation	General Electric Co., Denver, Colo	$54,847.27
1802	Deschutes, Oreg.	Aug. 5	Sand and coarse aggregate for concrete structures	Prineville Sand and Gravel Co., Prineville, Oreg.	52,121.25
1820	Davis Dam, Ariz.-Nev.	Aug. 13	Oil circuit breakers, disconnecting switches and lightning arresters for Davis switchyard.	General Electric Co., Denver, Colo	975,746.20
1820	Davis Dam, Ariz.-Nev.	do	Current transformers for Davis switchyard	Westinghouse Electric Corporation, Denver, Colo.	70,226.10
1823	Rio Grande, N. Mex.-Tex.	Aug. 20	Construction of Elephant Butte-Socorro 115-kilovolt transmission line.	Reynolds Elect. and Engr. Co., El Paso, Tex	356,859.33
1839	Columbia Basin, Wash.	Aug. 13	Neutral-grounding reactors and circuit breakers for station service units Grand Coulee power plant.	Westinghouse Electric Corporation, Denver, Colo.	11,399.00
1840	Columbia Basin, Wash.	Aug. 15	Structural steel for pumping plant building—Pasco pumping plant.	Pacific Coast and Foundry Co., Seattle, Wash.	13,716.00
1846	Hungry Horse, Mont.	Aug. 6	Construction earthwork and structures for relocation of forest service road.	F. R. Hewitt Co., Spokane, Wash.	632,428.00
1859	Davis Dam, Ariz.-Nev.	Aug. 1	Erecting 20 prefabricated houses at Davis Dam Government camp.	John Bohannan, Pacific Palisades, Calif.	104,400.00
1860	Klamath, Oreg.-Calif.	Aug. 13	Ten vertical-shaft pumping units for pumping plants—Tule Lake division.	Crane O'Fallon Co., Denver, Colo.	20,687.00
1863	Missouri Basin, Nebr.	Aug. 5	Electrical equipment for Gering, Bridgeport and Sidney substations.	General Electric Co., Denver, Colo.	22,360.00
1865	Deschutes, Oreg.	Aug. 7	Construction earthwork and structures for 10 miles of North unit Main Canal.	Adler Construction Co., Redmond, Oreg.	219,355.00
1867	Provo River, Utah	Aug. 5	Two bypass valves for Jordan Narrows pumping plant	Pacific Coast Engineering Co., Alameda, Calif.	12,450.00
1874	Deschutes, Oreg.	Aug. 18	Construction earthwork and structures laterals M-57 to M-64A	W. C. Bauman Co., Portland, Oreg.	299,301.00
1876	Provo River, Utah	Aug. 14	Construction Jordan Narrows pumping plant, siphon, penstock discharge pipes and wasteway.	Carl B. Warren, Pleasant Grove, Utah	549,299.40
1890	Missouri Basin-Boysen, Wyo.	Aug. 29	Construction of Boysen Dam, power plant, and relocation of Chicago, Burlington & Quincy R. R.	Morrison-Knudsen Co., Inc., Boise, Idaho	13,899,999.30
R-2-10	Region 2, California	Aug. 7	Erecting 42 prefabricated houses at Tracy Government camp	Wallace D. Harkins, Inc., San Francisco, Calif.	66,930.00
R-2-10	do	Aug. 12	Erecting 8 prefabricated houses and constructing water systems, driveways and sidewalks at Antioch Government camp.	O. C. Furaman, Antioch, Calif.	26,931.32
R-2-10	do	do	Construction of water systems, streets and walks at Tracy Government camp.	Karl C. Harmeling, Stockton, Calif.	30,618.28
B-139	Central Valley, Calif.	Aug. 8	Reinforcing steel for Delta-Mendota Canal	Bethlehem Pacific Coast Steel Corporation, San Francisco, Calif.	95,675.85
34	Missouri Basin, Mont.	Aug. 7	Photo-index maps	Fairchild Aerial Surveys, Inc., Los Angeles, Calif.	15,742.00

CONSTRUCTION AND SUPPLIES FOR WHICH BIDS WILL BE REQUESTED DURING OCTOBER 1947

Estimated date bids to be invited	Project	Description of work or material
Oct. 1	Davis Dam, Ariz.-Nev	Erection of 10 two-car garages at Davis Dam Government camp.
Do	do	Erection of 20 prefabricated houses at Davis Dam Government camp.
Oct. 15	do	Construction of 83 miles of 230-kilovolt transmission line from Davis Dam to Parker Dam. Steel structures and towers.
Do	Tucumcari, N. Mex	Construction of earthwork and structures for Saxon lateral to irrigate 150 acres of land near Tucumcari, N. Mex.
Do	W. C. Austin, Okla	Construction of Ozark laterals and structures for irrigation of 9,300 acres of land near Altus, Okla.
Do	Missouri Basin, Colo.-Nebr	Construction of 45 miles of 115-kilovolt transmission line from Sterling, Colo., to Sidney, Nebr. Wood poles.
Oct. 1	Missouri Basin-Canyon Ferry, Mont	Construction of Canyon Ferry government camp electrical distribution system.
Do	Owyhee, Oreg.	Construction of Locket Gulch Wasteway on North Canal and Owyhee ditch crossing near Nyssa, Oreg.
Oct. 7	Central Valley, Calif.	Construction of earthwork, lining and structures for 14.5 miles of Friant-Kern Canal near Visalia, Calif.
Oct. 15	Missouri Basin, Nebr	Construction of Medicine Creek Dam, an earthfill structure approximately 107 feet in height and 3,600 feet long near Cambridge, Nebr.
Do	Missouri Basin, N. Dak	Construction of Heart Butte Dam, an earthfill structure approximately 125 feet in height and 1,850 feet long and relocation of State Highway 49, approximately 50 miles southwest of Bismarck, N. Dak.
Do	Missouri Basin-Canyon Ferry, Mont	Construction of office, dormitory, garage and shop; 8 four-room, 4 five-room, and 3 six-room residences for government camp.
Oct. 10	Colorado-Big Thompson, Colorado	Construction of 20 miles of 115-kilovolt transmission line from Greeley to Loveland, Colo. Wood poles.
Oct. 15	Central Valley, Calif.	Construction of earthwork, lining and structures for 13.6 miles of Delta-Mendota Canal near Fresno, Calif.
Do	Klamath, Oreg.-Calif.	Construction of Adams 60 c. f. s. concrete pumping plant near Merrill, Oreg.
Do	Boulder Canyon, Nev	Laying 6 miles of 12- and 14-inch diameter high-pressure steel pipe and erection of 50,000 and 2,000,000 gallon storage tanks at Boulder City, Nev.
Do	Boise, Idaho	Construction of earthwork and structures for Sand Hollow Wasteway near Caldwell, Idaho.
Do	do	Construction of earthwork and structures for Willow Creek Wasteway near Middleton, Idaho.
Do	Deschutes, Oreg.	Construction of earthwork and structures for Mud Springs Creek lateral to serve 8,500 acres of land near Madras, Oreg.
Oct. 24	Colorado-Big Thompson, Colo	Construction of earthwork, lining and structures for 10 miles of Horsetooth Feeder Canal including a diversion dam, a 1-mile tunnel, 12 concrete siphons, and 1 steel siphon near Loveland, Colo.
Oct. 30	Davis Dam, Ariz.-Nev	70-ton governor gallery crane for Davis Dam.
Oct. 31	All-American Canal, Calif.	Construction of flood protection dikes No. 1 and No. 2, Coachella division.

NEXT MONTH

***SPOTLIGHT ON THE PIONEERS*—What the Tule Lake settlers, one of the most widely publicized groups of veterans in the West, have accomplished in less than a year of homesteading.**

Also

***UTAH'S WATER COURTS*—Colorful anecdotes illustrating how the early Mormons settled their difficulties in Church Courts over the distribution of irrigation water.**

Harvest Time ~ *Then and Now*

This rare photo, taken around 1912 or 1915 and made available by the family of th late Judge Austin (see page 227), shows a sweetpotato harvest on Mr. Fullerton irrigated farm at Olustee, Okla. The modern harvest scene below (San Luis Valle Colo.) shows trucks and machinery replacing horse-drawn equipment of earlier day

NOVEMBER
1947

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11

Featuring:

●

Take RECLAMATION off the *Merry-Go-Round*
by
Commissioner Straus

●

THE POWER SHORTAGE
by
Arthur Goldschmidt

●

SPOTLIGHT* on the *PIONEERS

THE *Reclamation* ERA

Cause for Thanksgiving

Photo by F. B. Pomeroy, Region I

New Forage for Dairy Cattle

Three-year-old Kathleen Hampton reaches upward for the head of 10-foot feeder corn being grown on the Bureau of Reclamation's Development Farm No. 1, near Moses Lake, Wash., on the Columbia Basin project of Washington. Holding her is her father, Kenneth Hampton, wounded veteran of World War II, who grew up on irrigated farms of Washington and Idaho and was selected to operate the farm for the Bureau. The corn, representing the first test planting by the Bureau of Reclamation in the project, is Hybrid 939 and will be used as forage for dairy cattle. Because of delays in completing an irrigation well, Hybrid 939 got a late start in the 1947 season. The Moses Lake farm, one of several planned on the Nation's biggest reclamation project, is a joint undertaking of the Bureau of Reclamation, Bureau of Plant Industry, and Washington State College.

Next Month

How the Boise and Owhyee projects in southwestern and eastern Oregon produced 60 percent of the Nation's sweet corn seed supply in 1947. Also the story of hybrid sweet corn seed production (of which 80 percent of the entire country's requirements are grown on these two projects).

Reclamation ERA

Vol. 33 November 1947 No. 11

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Ruth F. Sadler, *Editor*

Our Front Cover

Pioneer Woman of 1947

Eleanor Jane Bolesta (pronounced Bo-*leh*-sta), ex-WAVE, lady homesteader in action on her modern irrigation farm, typifies the spirit of the new settlers on the Tule Lake division of the Klamath project in Washington-Oregon. Eleanor and her husband Charles, a marine who is recuperating from injuries received at Guam, have already made themselves a home and this fall will reap their first harvest. They feel they are the luckiest couple on earth—the land is wonderful, the neighbors are congenial, and the climate is exactly what the doctor ordered.

See page 237 for more data on Reclamation's first postwar group of settlers.

THE WHITE HOUSE

WASHINGTON

MY DEAR JUDGE SAWYER: I regret not being able to attend your annual convention in Phoenix this year, but I am confident that my representatives from the Department of the Interior and you leaders in the national reclamation movement will work out a basis for successfully extending the program of water conservation and utilization in the Western States.

In the past 45 years reclamation development has been proven as a means of attaining better living in the 17 Western States. Over 4 million acres of land have been irrigated, more than 2 million kilowatts of hydroelectric capacity have been installed, and flood waters have been held back and utilized. These achievements, great as they are, are not great enough to meet the problems facing us today. The conservation and wise use of our natural resources are essential to our existence as a Nation.

In my messages to the Congress this year, I stressed that the major opportunity of our generation to increase the wealth of the Nation lies in the development of great river basins. To fulfill that opportunity, an orderly program of appropriations is needed. Development plans of the required magnitude can be executed efficiently only if the responsible agencies have knowledge of the funds they may expect over a period of years. Efficiency and economy in our major domestic productive expenditures demand a long-range appropriation program.

Adoption of such a program now would reaffirm our democratic processes. It would extend in practice the principle of family-size farms for our citizens and would be evidence to the truth that effective utilization of our national resources lies in their development for the benefit of the greatest number of people.

I hope your association and other western groups can work out the means for providing that the reclamation structures already begun are completed soon, and for developing our western river basins on a scale which will meet the requirements of the Nation.

Sincerely yours,

Harry Truman

Hon. Robert W. Sawyer,
President, National Reclamation Association,
c/o Westward Ho Hotel,
Phoenix, Ariz.

United States Department of the Interior

J. A. Krug, Secretary

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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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Letters to the Editor

Contrast Apparent

WILLISTON, N. DAK.,
August 2, 1947.

DEAR EDITOR: I am highly appreciative of your letter of July 15 concerning the information which I submitted on the home of Mr. Joseph Paulson for publication in the June issue of the RECLAMATION ERA.

At present, the small grain crops both on dryland and irrigation in this part of North Dakota are approaching the harvest stage. We anticipate a good crop in both cases, but it appears that the dryland crops may be somewhat shriveled due to lack of rainfall and exceptionally high temperatures. For this reason there is a very high contrast apparent even to the casual observer between the dryland and irrigated crops.

No doubt you have seen this many times, but the people in this area are constantly becoming more and more impressed with this difference, and of course with the proposed operations of your Department the interest and stimulation here is very keen.

Sincerely,

ARLON G. HAZEN,
Associate Agricultural Engineering Superintendent, North Dakota Agricultural Experiment Station., Williston, N. Dak.

Editors, Please Copy

PORTLAND, OREG.,
September 18, 1947.

DEAR EDITOR: We refer now to your volume 33, number 9, September 1947, of RECLAMATION ERA, and the article on pages 192 and 193, by K. W. Sawyer, manager of the agricultural department of the Portland Chamber of Commerce, entitled "Sprinkler Irrigation in the Willamette Valley."

We have been particularly impressed by this article, and, of course, knowing Mr. Sawyer well through his activities in our local agriculture, are quite anxious to have 1,000 reprints of the article just as it is laid out in your magazine.

We would appreciate hearing from you as to the proper procedure for obtaining these reprints, and, of course, if it is at all possible, would prefer to have the 1,000 copies from your publishing department. In the event that it is not possible for you to furnish the reprints, we, of course, would then like to have permission to reproduce our own photostatic copies locally.

We of the Northwest are, of course, indebted to you for your decision to run such an article concerning a subject of such vital importance to our national agriculture, and will certainly look forward to additional material of this type as time goes along.

Looking forward to hearing from you regarding the above, we remain,

Very truly yours,

ROBERT M. MORGAN,
Sales Manager, Irrigation Division, R. M. Wade & Co.

¶ Many thanks to reader Morgan. Our readers are freely permitted to reproduce articles and photographs which appear in the RECLAMATION ERA. Credit lines and copies of material reproduced are always greatly appreciated.—Ed.

Voice of a Veteran

CRAWFORDSVILLE, IND., *August 16, 1947.*

RECLAMATION ERA,
Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

DEAR SIRS: Inclosed find check for $1 covering a 1-year subscription to your publication, RECLAMATION ERA, to be sent to the above address.

If possible, start my subscription with the August issue. I have the July issue. It is a wonderful piece of work. I am especially interested in this publication because I am a veteran intending to homestead on a Reclamation project.

Thanks for the July issue and congratulations to you on being able to put out such an informing and practical publication for the would-be homesteader.

Yours very truly,

L. L. PATTON,
113 E. College St.

FIELD DAY IN THE FALL

by Wynne Rowlands

Delta District, Region II, Sacramento, Calif.

Two crops of wheat a year, new marketing developments for ramie and the castor bean, added poundage for stock pastured on an improved ladino clover, and progress in reducing the amount of damage by the corn earworm were the highlights of the first fall field day to be held by the agronomy division of the University of California at its Davis, Calif., experimental grounds on September 5, 1947.

Twice as many people as were expected turned out for this all-day review of the experimental crops of today which may become the cash crops of tomorrow.

Among the crops made possible through California's long growing season was a plot of green wheat, nicely headed out and about to mature. At the Davis fields two crops of grain a year are grown to speed up plant-breeding work. The 12-month program for grain production consists of sowing in November, harvesting by June, planting again before July and harvesting in late October. The July-October crop, like the irrigated pastures in the area, must be irrigated about once a week.

An improved ladino plot added 600 pounds of mutton per acre of pasture last year. This improved ladino consists of common ladino mixture from which the inferior types were eliminated and has carried from two to three times the usual number of animals. Although pasture management seems to be the more important factor in weight gains, visitors could plainly see a very marked difference in the growth between the improved and common ladino plots with the same treatment.

From the response and keen interest shown, the fall meet will be a regular function. In the past the agronomy division has held a spring field day only.

The program was arranged by the acting chairman of the division of agronomy at Davis, Calif., Mr. F. N. Briggs. Lectures at the various plots were made over an efficient portable public address system as the visitors looked over plots including field corn investigations, summer legumes, lima beans, ming beans, blackeye beans, cereal rust nursery, sweet corn improvement (to reduce the amount of damage by the corn earworm), dry and snap bean varieties, pasture plants, castor bean trials (to develop a nonshattering type of bean suitable for commercial production), irrigated pasture legumes, ramie, alfalfa improvement, and alfalfa seed production. •

The POWER Shortage

by Arthur Goldschmidt

Former Director, Division of Power, United States Department of the Interior*

THE Department of the Interior, through its various agencies, is engaged in marketing power from existing dams and projects under construction in States comprising more than four-fifths of the Nation's area.

The Department's combined power wholesaling job already involves more kilowatt-hours than that of any other agency, public or private. Power demands throughout the areas in which the Department operates are forcing tremendous increases in this capacity.

Reclamation's Power Plans

Throughout the 17 Western States, the Bureau of Reclamation is working on a program of multiple-purpose water developments that will more than double its existing two-million-odd kilowatts of capacity within the next 6 years. In these States and eastward to the Atlantic, the Corps of Engineers is undertaking construction on water-control programs that will develop another million and a quarter kilowatts of power, or twice the capacity already installed in its dams. In the Southwest the Corps of Engineers is doubling the capacity of the existing dams and has additional projects under construction. In the Northwest, scheduled additions to the Columbia River development required by the Bonneville Power Administration look to making available another 745,000 kilowatts of capacity, and requirements indicate that another 1½ million will be needed by 1953.

The Corps of Engineers and the Bureau of Reclamation are continuing their surveys for the multiple-purpose developments of the rivers of America, and tremendous additions to the power capacity figures already mentioned are in the making. Although these figures seem large, we can today, without fear of the ridicule of the past, ask: Will this be enough? Will these plans and projects, even if brought into production at the earliest possible moment, catch up with the tremendous power demands that are currently swamping us? Are our sights high enough?

The answer is simply that this is not enough. Neither our present nor our prospective power supply is adequate to maintain full production and full employment.

**Recently appointed executive vice chairman of the interdepartmental technical committee which will plan the International Scientific Conference on the Conservation and Utilization of Natural Resources.*

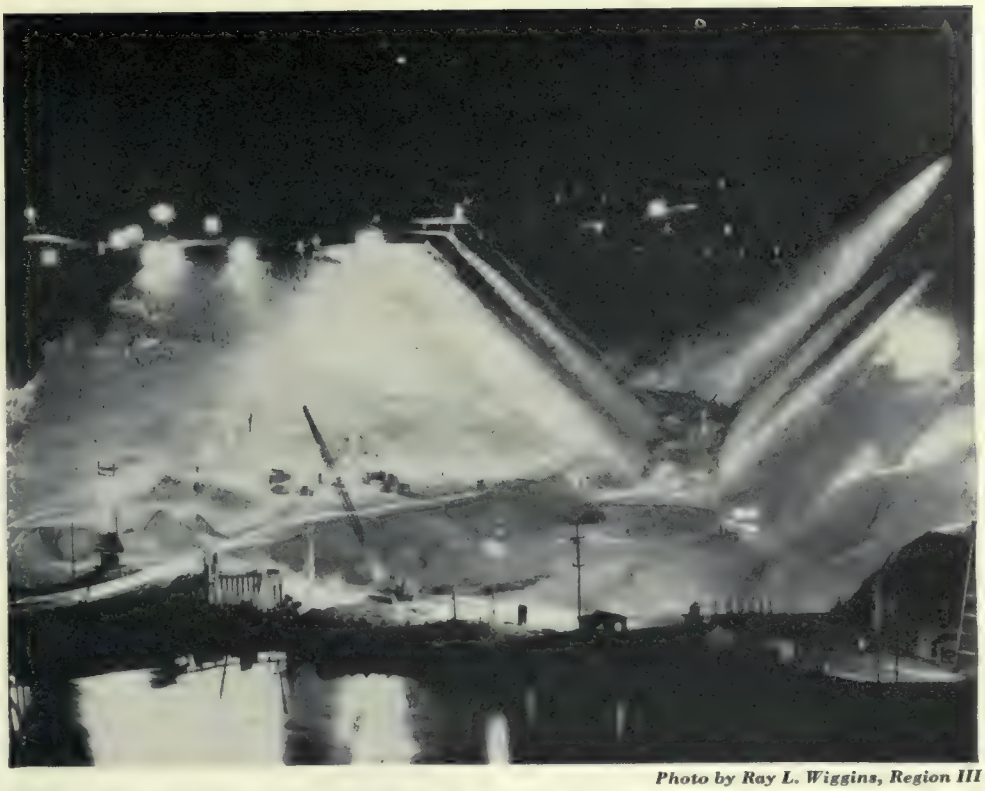

Photo by Ray L. Wiggins, Region III

THE FUTURE LOOKS BLACK—*even with work going on night and day at such potential power-makers as Davis Dam on the Colorado River.*

In this Nation, power supply has become a basic factor in our way of life and in our ways of making a living. When we plan, authorize, and budget additional power capacity in the power business, we must take into account the planning, authorizing, and budgeting of our consumers. The millions of farmers, the householders, shopkeepers, businessmen, and industrialists are planning, authorizing, and budgeting for power consuming appliances and equipment. The result is that we have outgrown our plants. We threaten to outgrow our plans.

The total number of consumers of the electric industry has risen to over 36 million. The average annual residential use of power has increased to 1,296 kilowatt hours from 735 kilowatt hours 10 years ago, an increase of 76 percent. We know that this figure is not a stopping point, for in the State of Washington where abundant low-cost power has been available, the annual residential use is now about 3,000 kilowatt hours.

Business and industry are using more power than ever before. The Nation's primary aluminum load alone has increased from about 4 billion kilowatt hours in 1940 to the rate of about 10 billion annually today. This spring the Nation consumed over 4½ billion kilowatt hours each week compared to 2 billion weekly 10 years ago.

These figures did not just happen. They are not an accident. The tremendous increase in the use of electricity in our Nation has come about as a result of definite programs and policies intended to bring it about. We as a Nation set out to make power widely available to the people under programs and policies designed for that purpose. The Congress undertook to encourage multiple-purpose water conservation and development programs that would make large power supplies available at low cost. We undertook as a matter of national policy to get those power supplies to the people. We undertook to encourage wider rural electrification for the Nation's benefit. These policies have been consistent and interdependent. Low-cost hydro power has made many Rural Electrification projects feasible, and low rates to consumers have made Interior Department projects pay out.

The power policies and programs thus undertaken in the past few years reflect the best of our American tradition in business, finance, and government. They were not particularly new when they were reenacted in the Bonneville and TVA Acts, the Rural Electrification Act, and the Flood Control Act of 1944. But in these and other acts, the Congress supplied the missing ingredient: action.

Congress authorized the jobs to be done and made the funds available to do them. Sound policies were backed up by concrete and steel, copper and aluminum, in dams and transmission lines. These policies and programs are a part of progressive Ameri-

can thinking, our desire to develop and grow, to build bigger and better and to greater purpose. The same policies that have brought about our greater use of power have been tested in business as well as Government with the same result. They constitute the dynamics of the American economy.

This policy of not selling short on America's capacity for continued growth has also been the basis of the Government's program of placing generators in dams it was building for other purposes, and of carrying the power to prospective markets. Those generators and transmission facilities were ordered ahead of the market demand—and they created that demand.

We are today selling all of the power that we can produce and are returning the cost of its production to the Government. We see no let-up in this demand.

Let us draw one further analogy. The Ford policy of mass production for mass consumption did not injure the automobile industry. He made the country car-conscious and the spur of his competition was a driving force in the industry. Whether they derided his efforts or feared them, his competitors were benefited by Ford's policies.

Today the public power capacity of the Nation is larger than ever before and represents about one-fifth of the national capacity.

Private Power Profits

According to the Edison Institute the profits of the private utility industry in 1946 rose to 685 million dollars, increasing more than 20 percent over 1945. Never had publicly owned power been a larger percentage of the total power available in America—and yet never have the profits of the private industry been higher.

The fact is that the bold development of power resources and the sound mass consumption pricing policies of public agencies have started a chain reaction in the development of the American power market. The current sharp upward trend in power demand is creating our most immediately pressing problem. Today, we can no longer build ahead of demand. Even if all agencies, public and private, got together with the greatest combined effort, we could not meet present demands for power. To be sure, the shortage of material supplies to add new customers is in many cases putting off the day of reckoning on power supply. But the Nation as a whole is today operating its power system by heavy encroachments on its reserves.

The combined national peak was 93 percent of the total dependable capacity of class-I utilities in January. This means we had an average of only 7 percent reserves. Many important power areas are operating well above their net assured capacity. We are relying on luck. England's power experience last spring with unusual weather provides us with an example of the dangers and hardships that can result from relying upon inadequate power supplies.

We must as a Nation do everything possible to catch up with ourselves and get on a sound basis of power supply. This country cannot defend itself without adequate power. We cannot, moreover, maintain a sound level of employment or business activity or even our standard of living without adequate power. We must not cynically rely upon the inevitability of recessions.

Indeed, nothing short of a depression, with its toll of national insecurity and individual hardships can prevent us from hitting the ceiling of our power supply with serious repercussions, unless public and private agencies both buckle down to the task of getting every available kilowatt on the line as quickly as possible.

A short recession cannot solve our problem even if it were sound to count on it.

Our three generator manufacturers can put out only equipment capable of generating about 12.5 million kilowatts in the next 3 years. Increases in plant capacity, if they can be completed, may bring this up another 1½ millions by 1949. This must take care of all electrical capacity, including foreign orders. The excessively long delivery time of 27 to 39 months for power transformers and the shortage in distribution transformer manufacturing capacity and the difficulties of getting other materials add to our problem. It is evident that manufacturing capability must be increased.

Let us look down the next 10 years.

Assuming the 4½ percent rate of growth in peaks that was experienced by our power systems from 1930 to 1939, a period that included a major depression, we will need 26 million kilowatts of additions to our installed capacity to meet our peaks in 1957 without reserves. We are not using the so-called "abnormal" increase of more than 12 percent in the peak in the last year because we are developing a very conservative estimate.

Assume only 15 percent as average national reserve, and our total requirements for 1957 will be 84 million kilowatts. We have allowed for no retirements nor for the rate of growth we have experienced since the war. This must be our minimum target.

The growths of this year and next cannot be met with adequate reserves—but we must plan to get upon at least this footing before our 10 years are up.

This means that every kilowatt of Federal capacity now on order and every project having power potentialities must be hastened to completion as rapidly as possible.

For American industry cannot operate its electrical equipment on excuses—or even on reasons for power deficiencies. American farmers cannot electrify their farms on promises of more capacity.

Just what constitutes a shortage?

There is never a meat shortage among vegetarians. Doubtless there are large areas in the world with a fraction of our own electrical capacity, where there is no bottleneck in power or transformers or consumers' equipment. But we cannot compare the power requirements of our highly complex economy with those of any other nation in the world.

When we ushered in the age of electricity we moved down a road from which there is no turning back. Some people may prefer the good old days of the smoky lamp and the old oaken bucket, but there are not enough such lamps and buckets to go around, and there are not adequate means of keeping them in use today.

This Nation needs and will continue to need more electric power than any comparable nation on earth for its day-to-day living. It needs more power for its day-to-day production. Coulee kilowatts are used in the Northwest instead of coolie labor, and there is no way to reverse this process of substitution. All the manpower in the region cannot replace electricity in the production of aluminum. Nor can manpower replace electrical power in the tremendous pumping operations on the irrigated lands in this area.

We cannot replace machines with men and maintain our level of living or our national security.

Almost everyone is aware that we have greater electrical capacity than any other nation in the world. But to a large degree our kilowatt strength is a measure of our weakness. A knight in full armour may have been able to win over a group of unprotected fighters. But he must depend upon the Percheron that was bred to carry him. We, too, are dependent upon our horsepowers, and cannot maintain our production, our health, or our national security without them.

We cannot take electricity from our homes, shops, and factories and switch it to other uses at a moment's notice or at all.

Our food habits, for instance, are based upon ample refrigeration in the home, in the markets, and in transportation—all requiring electricity. Our sanitary facilities are dependent upon electrically driven pumps for which there is now no substitute in most of our crowded urban areas.

This requirement that we have power for our national health and security is not only true of our cities, although here it is a fact to an absolute degree.

On the farm, the introduction of electricity has increased our capacity to produce manyfold—and we are dependent upon this increased capacity to produce. Moreover, any effort to move backward, even temporarily, to the use of other than electrical means of refrigeration, heating, cooling, water pumping, cooking would require equipment that no longer exists or makeshifts for which there is not the manpower on our farms to operate.

So it is safe to assume that electric power is here to stay. But if it is to do the job that only it can do, in providing the basis for a strong national economy, we must move ahead to install additional capacity as rapidly as it can be fabricated.

(*Continued on Page 240*)

Utah's "Water Courts"

How the Law of Riparian Rights Was Discarded and the Mormons Settled Their Disputes Over Water

by William R. Palmer

Chairman, Iron City Centennial Committee

As the people of Utah celebrate their centennial this year, they are also celebrating a century of progress in irrigation law.

When the Mormons arrived in the Great Salt Lake Basin in 1847, it was Mexican territory inhabited only by roving bands of Indians and an occasional white trapper.

Among the problems which confronted the settlers was that of distribution of the meager water supply for irrigation purposes. There was no water law in the eastern States or in England applicable to controversies over irrigation water, and the Mormons had no precedent to follow.

Under the English common law of riparian rights, a man could impound the water, divert it from its natural channel, pollute it, or do anything he pleased so long as it was on his property.

The Mormons have been called "the fathers of irrigation." They were not, however, the first to irrigate land in the West.

There is ample evidence that Indian tribes in the arid regions of the West practiced irrigation long before the first white man visited the area. And it is well known that the Catholic missionaries in California and along the Rio Grande River in New Mexico had been irrigating their vineyards before the Mormons came to Utah.

Brigham Young and his people were, however, the first to stake their all on artificial application of moisture to the soil. To them belongs the credit for first developing and reducing irrigation to something of a science.

The Missions had abundant water supply, comparatively small tracts of land under cultivation, and ownership of the property was all in one holder.

The Mormons had wide deserts of thirsty land and small, varying, and uncertain mountain streams which, to the end that "every man might raise his own bread" had to be divided equitably among many inexperienced users. The law of riparian rights was exactly opposite from the thing these people needed.

The common-law doctrine of riparian rights, under which only the owners of land adjacent to natural streams had correlative rights in the water, was not appropriate for conditions existing in the arid Salt Lake Valley. It was promptly repudiated and a new law had to be devised. It is interesting to note that the water law based on custom and justice which developed in the isolated Utah communities, and elsewhere in the West, had one thing in common which was foreign to the common law. Beneficial use was declared to be the basis, the measure, and the limit of a water right.

The Author

William R. Palmer was born at Cedar City, Utah, on May 7, 1877, and has lived there all his life.

During the years of his business life (banking, merchandising, and livestock), Mr. Palmer was active also in his church. For 12 years he was clerk and historian for the Parowan Stake of Zion (compares with a county in area and population).

For 4 years he was a bishop and presided over a bishop's court. Later, for 15 years, he was president over this same Stake and, as such, presided over its high council court. These offices gave him access to all the earlier church records for his region, including the water adjudication trials.

For over 20 years Mr. Palmer has been a member of the board of control of the Utah State Historical Society and is now State archivist for Utah. He is the author of many published articles on Utah Indians, western pioneering, and a recent book, *Pahute Indian Legends.*

After being driven from Missouri and Illinois, Brigham Young had said, "If there is a place so utterly forbidding and undesirable that no one else will want to live there, that is where we will go," and, "If our enemies will leave us alone for 10 years we will ask no odds of anyone." The Great Basin, according to trapper tradition, was just such a place, and here Brigham Young had led his impoverished people.

But of all the pioneering in America, the Mormons in the Great Basin had the least right to expect to succeed. They had chosen the toughest country of all to conquer and they were the least prepared with material resources and experience. Almost every card in the reclamation pack was stacked against them. For them, in the most literal sense, it was a case of "root hog or die."

The Mormons, however, did have one intangible asset which other more favored pioneers lacked and which counterbalanced all their handicaps. They had a vital unity of purpose and a constructive philosophy of life under which they could focus their meager resources on a common cause. "The earth is the Lord's and the mission of man is to subdue it and make it fruitful." To them, the reclaiming of a desert was "building up the Kingdom of God on earth" as much as proselyting for converts. This materialistic spirituality kept them united and happy and enabled them always to set community interest above individual gain. It enabled them also to set up their own courts—church courts—to adjudicate the ever-insistent problems which arose between members of the church and to harmonize their disagreements. Among these, of course, included disputes as to the use of water.

Every Mormon town was settled by a group of people who had been selected, organized, and sent there to found a settlement. They first surveyed their townsite, drew for lots, built a fort and a meeting house which served also for school and recreation center. The fields, close to town, were divided into 5- and 10-acre plots, and these were allotted to heads of families according to the size of their families. These small fields were all enclosed in a common fence and drew irrigation water through a common canal.

As already noted, the Mormons set themselves at once against the doctrine of riparian rights. They substituted the principle of "beneficial use of water." Brigham Young said, "No man has a right to waste one drop of water that another man can turn into bread." The principle was laid down that water belongs to the people and no man can gain title to more than he can use in a beneficial manner.

That question of beneficial use of water posed an endless lot of experimentation and adjudication to clarify its meaning. What constituted beneficial use of water? How much water would a given crop require? How often should it be applied? Could a man help himself to the stream

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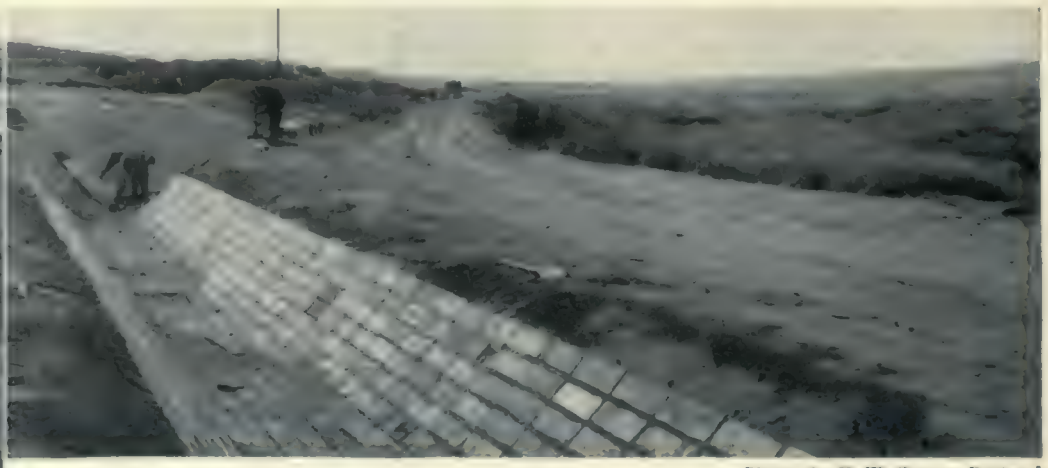
Try-Outs for Precast Canal Linings

by Van E. Nutley

Field Engineer, Roza Division, Yakima Project, Wash., Region 1

ABOVE: *precasting 2' by 2' blocks.* AT RIGHT: *easy-to-handle 8'' by 2' size demonstrates interlocking feature.*

Photos by Claude Studebaker, Region 1



Photos by K. W. Casper, Region 1

AT LEFT: *hand-placing 2' by 2' blocks.* ABOVE: *completing weed-resistant and erosion proof 8'' by 2' lined lateral.*

One of the more interesting experiments in the Bureau's low-cost canal lining program for small canals was conducted on the Roza Division of the Yakima project late in the fall of 1945 and 1946. These experimental linings involved the placing of concrete—first, by the gunite method and then by the use of precast blocks.

Concrete linings placed by the gunite method are not unusual, but the section lined with interlocking precast concrete blocks may lead to more widespread use of this type of material. The Portland Cement Association participated with the Bureau in the design and construction of both of the sections of experimental canal lining mentioned. Two types of precast concrete blocks were used, one having been suggested by the Portland Cement Association and the other designed by the Bureau of Reclamation. The Portland Cement Association type block measured 8 by 24 by 2 inches, while the Bureau-designed block measured 24 by 24 by 2 inches or 2½ inches. The thicker Bureau-designed block was used for the canal bottom.

The east turbine lateral at mile 3 was chosen for the experiment because excessive seepage had been experienced on this section, which had been placed in service during the 1945 irrigation season. The precast blocks were used only in the straight or tangent section of the canal without attempting to adapt their usage for a curved section which was lined with gunite. The straight section of canal has a 4-foot base and one to one side slopes.

The Yakima Cement Products Co. manufactured all the blocks used in this experiment, using demountable steel forms which were removed while the concrete was green. Blocks themselves were hand-finished with a steel trowel and cured with Hunt-clear curing compound. The batch for all precast blocks consisted of one part of cement to $2\frac{1}{2}$ parts of sand and $3\frac{1}{2}$ parts of gravel.

Because of the requirement for carefully prepared and aligned subgrade upon which to lay the precast blocks through this section of the canal and the unstable sandy soil, it was found necessary to shape the canal by hand-tamping methods immediately ahead of the crew placing the blocks. All of the interlocking blocks were laid with an internal setup mastic consisting of 8 percent fibered asbestos, 4 percent diatomaceous earth, 45 percent dry asbestos, 35 percent liquid asphalt, and 8 percent impregnator "D". It was found that while this mastic has very desirable characteristics for this type of use, it had to be applied to the interlocking edges of the blocks with a hand trowel. The 2-foot square Bureau-designed blocks weighed between 100 and 150 pounds and were laid in rows lengthwise of the canal section beginning with the base blocks. The smaller cement association blocks weighed only 34 pounds and

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Take RECLAMATION off the *MERRY-GO-ROUND*

Extracts from the address of United States Commissioner of Reclamation Michael W. Straus before the sixteenth annual convention of the National Reclamation Association at Phoenix, Ariz., on October 30, 1947.

For the second time, as Commissioner of Reclamation, I have an opportunity to present my annual report to the advocates of reclamation and western resource development, and want particularly to plead for united action to achieve a firm, continuing, and steadily progressive national program for reclamation.

To attain its destiny, the arid West must, as a prerequisite, take its basic reclamation program off the merry-go-round of circumstance. It must put it on an orderly basis and keep it there with a clear and ratified program looking forward at least 7 years, planned and scheduled in advance so that the West and its responsible officials can hope to plan their development on solid foundations and carry out their plans immune from the vagaries of happenstance.

In the past decades, reclamation programs have, by various and sometimes temporary jurisdictions, been alternately cleared and blocked, speeded and slowed down, frozen and thawed, and commanded to "Giddap" and then "Whoa."

As one of the great construction programs of the world, reclamation requires better treatment.

This country cannot accomplish a multiple-billion-dollar complex program by alternately squeezing it fat and then stretching it thin as if it were an accordion—at least, it cannot be done on an economical and rational basis.

That is why we must achieve the orderly security of a basic continuing program, on which the country can rely, looking a reasonable span of years into the future.

This has been a crowded and adventurous year for reclamation. The past 12 months have witnessed the greatest volume of reclamation work in the history of the West. Many difficulties were surmounted.

The year was marked by reclamation's greatest construction program, the greatest amount of water being spread on the greatest number of acres, the greatest irrigated crop production with the first half-billion-dollar Federal crop value, and the greatest power generation.

At the time of the greatest need, reclamation produced the greatest amount of food while irrigationists enjoyed the greatest prosperity with the highest produce markets ever known.

The needs of the world, the Nation and the West for reclamation are increasing. A lot of people are getting hungry in this world. The United States, in some fashion, is going to feed a lot of them. Reclamation is going to do its share. Every area of the country, and particularly of the 17 Western reclamation States, daily demands more electrical energy at reasonable rates. Reclamation is going to provide its share. If we do not, the West will suffer for the simple reason that its growing population must have these necessary services.

On the question of population, the Bureau of the Census started its last report by saying, "A great westward movement of civilian population in the United States took place between the last census (1940) and 1946."

Western Population Booms

In what the Census calls "the West," which are the Mountain and Pacific States, population increased 28.3 percent with the highest increases in Washington, Oregon, California, and Arizona. In the remainder of the United States, increases were only 3 percent.

And when we compare new acreages brought under irrigation with this growth in population, we find that between 1940 and 1946 Reclamation increased new lands made productive for the first time by a full supply of project water by 5.3 percent in all the 17 reclamation States. Those same States reported an over-all gain in population of more than double the gain in new irrigated acreages—a gain of 12.7 percent in population.

Now, that is your problem, my problem, the Nation's problem. We are going to have to see those people get watered and fed as they can be watered and fed only on irrigated land, and that their new industries are sparked as they can be sparked only by new low-cost electrical energy.

That is why we say without qualification that, as the national debate goes forward on economy and budget, the one extravagance too vast to be reckoned by any bookkeeper's columns of dollars and cents is the mad extravagance of water wasting unused to the sea in a land that cries for water and food and power.

Economy is a word that means a lot of different things to a lot of different people. One thing it meant to some people was economy concentrated on the western reclamation program.

This is attributed to the fact that sincere and honest men were required for the first time to deal with a subject with which they were not familiar.

The new majority in the House of Representatives, principally from a humid area of the country where water generally and actually is a surplus—and frequently damaging—resource, had to have an opportunity to study the subject.

For 6 months a bright, white, and searching light played on reclamation. Those who challenged this program were only performing their duties according to their own true beliefs. It was a good thing that reclamation had to meet that challenge.

When the searchlight had concluded its swing over the West, the result was appropriations of about 100 million dollars of new money, which with funds heretofore made available made possible for you a sizable reclamation program of approximately 200 million dollars for this fiscal year. It is overwhelmingly construction.

That is not as large a program as the President asked for, or the Bureau of Reclamation reported was required, and it provides for fewer investigations. Mathematically, the new money is just a shade under the previous year's appropriations. It also happens to be approximately double the average annual appropriation for the past 10 years. The size and scope of the Reclamation Program today defies comparison with yesterday.

In other words, the Congress not only last year, but again this year, made the largest reclamation appropriations in history. By any interpretation, Congress affirmed its appreciation, support, and confidence in the West's reclamation program. And we might add that Congress did that in the face of a lot of divided counsel from the West itself.

The Congress, as a whole, seems to be ahead of some self-anointed spokesmen or any pleaders amongst us for special interests.

Just remember these facts when any prophets of doom or corporals of disaster tell you that the Congress does not support reclamation, or that it will not unless we junk this traditional policy or throw that policy in the ashcan.

Such advice completely and conveniently ignores the obvious fact that the time-tested policies some people now want exterminated are those that sprang from the West itself, were adopted by the Congress, ratified by legislation, and are mandatory upon Reclamation.

And that covers quite a few items—some highly controversial. It even covers some that are occasionally miscalled "novel social theories," such as the family-sized farm and the low-cost reclamation power requirements—both of which happen to be principles written into the law by the Congress

many years ago and, when attacked, confirmed by the Congress over and over again.

Reclamation has the funds. The Congress and the country have told us to roll the construction program. This we must do despite any legislative novelties that appeared in the guise of appropriation actions.

One was a limitation placed, without warning, on the amount of essential engineering and design work that the Bureau was permitted to do in Denver, Colo., the world headquarters of heavy construction engineering talent.

Another restriction was a prohibition against the Government doing work itself that was authorized and appropriated for in the reclamation program.

Both of these riders slow construction and increase costs ultimately to be met by water and power users. Reclamation will ask the Congress next session to knock off both of these handcuffs.

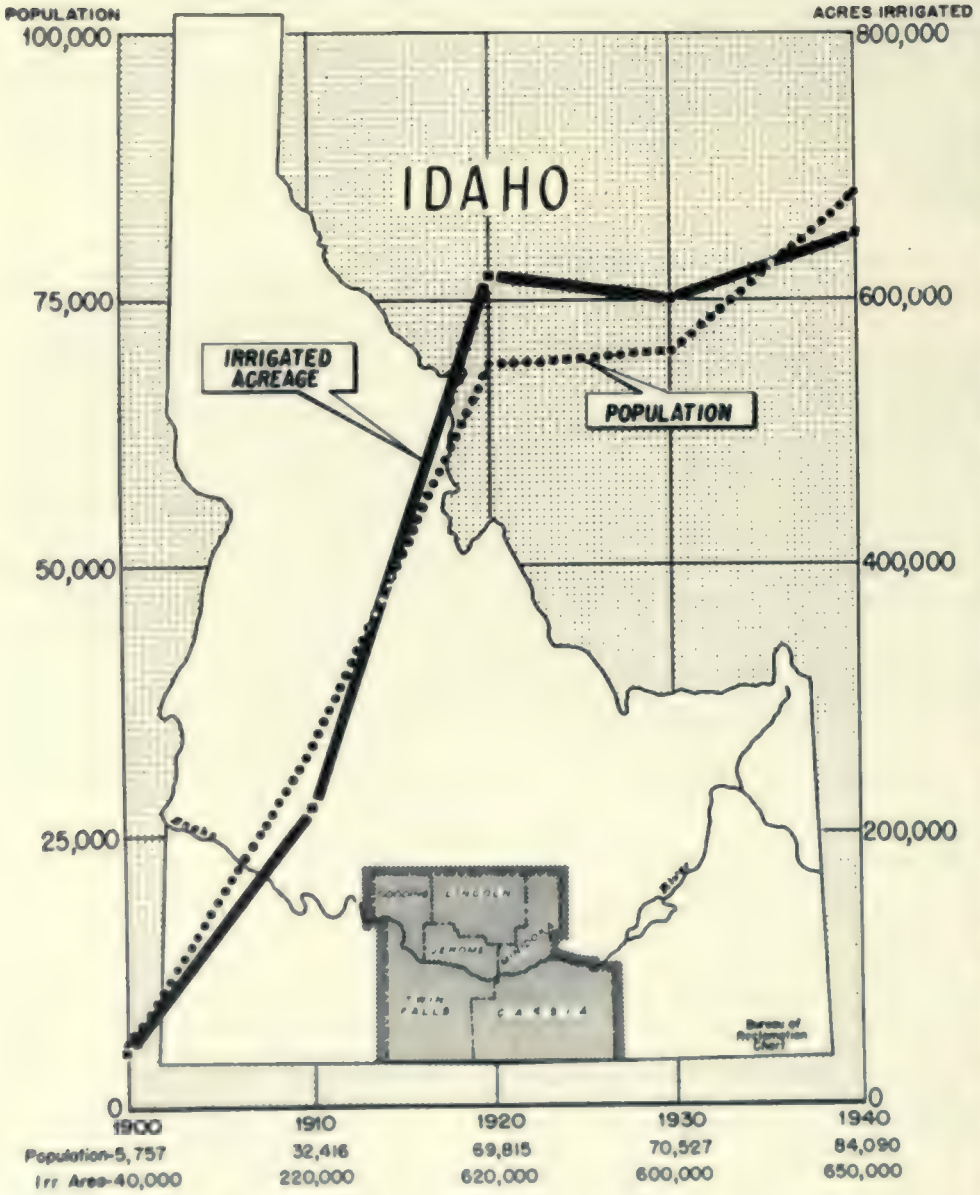
A basketful of Reclamation bills were enacted during the year, but the chief interest revolves around two measures. These were the Reclamation power rate bill and the bill to end acreage restriction.

The first power rate bill was, in my opinion, a conglomeration of assorted views going far beyond anything I ever heard discussed before this Association. Instead of liberalizing reclamation law, it would have made it harder for a reclamation project to win through.

Long hearings ensued in which the country was treated to the spectacle of the West divided against itself. But from this performance there emerged an entirely different bill.

IRRIGATION INCREASES POPULATION

Six Idaho Counties Which Without Irrigation Would Have Remained Desert



How the growth of population parallels the expansion of irrigated agriculture is graphically shown by this Bureau of Reclamation chart covering a 40-year period in six counties in southeastern Idaho. The 1940 population of the area was nearly 15 times greater than that of 1900 and the irrigated area slightly more than 16 times greater. The irrigation expansion has created more than $130,000,000 in property values, an annual pay roll of $63,000,000, 1,600 business enterprises, and jobs for 26,000 persons. Without irrigation this Twin Falls-Minidoka-Gooding section of the Snake River Valley would have remained as unproductive as the surrounding desert.

Rockwell Bill Summarized

This bill, known as the "Rockwell Bill," would do a number of things of vital importance.

- It would reduce the interest rate on the investment in power facilities on Reclamation projects from 3 to 2½ percent.
- It would settle the technical controversy over application of the interest component, and, by statutory action, would ratify application of not more than one-fifth of the interest component as a direct aid to irrigation on the project.
- It would fix the amortization period on power investment at 78 years or the useful life of the facilities, whichever is the shorter.

These sections of the bill alone have the effect of making more reclamation projects feasible by getting the West much needed lower-cost power while widening the power markets which reclamation can both serve and draw upon for revenues to support its multiple-purpose projects and give the required assistance, beyond irrigators' ability to pay, to irrigation works.

But, more important, provisions would be added by the legislation which would make nonreimbursable by water or power users those portions of the investments in features of multiple-purpose projects which might properly be allocated to development of recreation and fish and wildlife protection (which are common to most projects in the West), and, in addition, making nonreimbursable allocations for silt control (which is of vital importance particularly in the Southwest) and to general salinity control.

That bill, the "Rockwell Bill," House bill 2873, has been reported to the House of Representatives unanimously by its Public Lands Committee, and is also before the Senate as Senate bill 1608, introduced by Senator Butler, to be acted upon at the next session. It probably is not perfect. But, nevertheless, in its entirety it benefits the West's program and terminates controversies that have set Reclamationists against

(Continued on page 246)

SPOTLIGHT on the PIONEERS

by Orin Cassmore
Region II, Sacramento, Calif.

J. E. Fluharty, Region II

SKYLINE SURVEY *of his new homestead conducted by Walter Buchanan* (right) *with the aid of his father, Walter D. Buchanan, from a bluff overlooking the Klamath project.*

Latest reports from the Klamath project show that our present-day pioneers will have plenty of reasons for giving thanks this season.

It has been a hard year, but it has been a good year.

Something has been going on almost every week since March, when we went up to report on the choosing of farms by the 86 entrymen who were selected from the group of 172 whose names were drawn last December. The farm selection scene, as you might expect, continued the high level of drama that had started with the drawing.

This business was completed in January. Two months more were allowed for the settlers to pull stakes elsewhere and to look over the homestead lands so they could list the plots that were their first choices. Almost every veteran, usually with a coterie of advisers from the locality, tramped over the whole 7,500 acres, consulted with county agents and Bureau people. On March 13 everyone was at the project office bright and early.

Then E. L. Stephens, project superintendent, stepped to the big map at the front of the room and called up Robert L. Smith, of Banks, Oreg., first man. Mr. Smith got his first choice, of course. Then up came Gewin McCracken, of Arlington, Va. He got his, too. Then 3, 4, 5, and so on up to 86. Almost everybody was delighted, for almost all of them seemed to have gotten their first, second, or third choices. So nearly alike in productivity were the farm plots they laid out that almost every experienced farmer in the area evidently had a different idea as to which farm was the best.

The only unhappy man was one lad way down at the bottom of the list who was so sure the piece of land he wanted most would be taken that he did not write its number down. It turned out that no land in that area had been taken when he was called up, but he had forgotten the number, so had to be content with a random choice.

The only disagreement on the worth of any of the land came from Leland Cheyne, who had been farming in the Basin. Number 85, he declined to take either of the two pieces left, saying he believed that it would take too long to get either of them into profitable production. Eldred Charley, of Medford, did not think so, and accepted the last piece over the telephone while sick in bed at home.

Then came the mechanics of becoming a homesteader on an assembly line of desks stretching half way around the room: first the water-rental application for a particular piece of ground; then a desk to pay the water rental a year in advance; then presentation of the receipt and getting a certificate from the examining board as an eligible entryman; then to the Bureau of Land Management representative to fill out homestead entry forms and to be certified as indeed the operator and potential patentee of homestead number so and so. No gunplay; no surreys and buckboards dashing madly for a choice piece of property; no "Sooners," but the end of long months of an exhausting nervous grind that began when, rather hopelessly, the entryman had trudged about getting papers together last September, only hoping that he would be one of the lucky few in the group of 15,000 who requested application blanks.

Getting the farm was not, however, the end of frenzied activity, as we have noted before. There were celebrations and picnics and lunches and dinners and dancing in the project towns to greet the new homesteaders. There were homesteaders' meetings initiated by the Bureau in which the various problems—getting a postal route, water, electricity, roads, how to get barracks moved onto the lands—were discussed. There were a million things to do; planting time was breathing down their necks; every homesteader had from 4 or 5 to 14 letters from established farmers offering to lease his land for as high as $65 an acre for the 1947 season, a price which would give the

Thanksgiving—1947

Photo by J. E. Fluharty, Region II

PIONEERS *turn down the lure of easy "land lease" money and with teamwork and streamlined equipment make possible the center scene.*

"Amb

operator a good profit and the homesteader a chance to get his house up, his well dug and his yard and some shade trees planted, plus a sure and substantial income while doing so.

This seemed to be a very sound and intelligent program, the old slow-but-sure stuff, and we expected to find that most of the homesteaders were handling their land that way for the 1947 season.

Not so. When we took our first look at the previously bare plain from the bluff high above it in mid-May, we saw it dotted with houses; here and there a tree which could not have grown up in two months (Modoc County Agent Jack Hayes is dealing out the Chinese elms and Siberian peas) and everywhere the green of barley. Later we found that almost to a man they had broken and plowed and disked and seeded their own land in between trips to town to buy tractors with the funds the banks were willing to advance. And they and their wives had planted kitchen gardens and flower gardens and trees and seeded patches of lawn at the same time.

There was the Bolesta place, with iris growing in a garden patch at the edge of a nice stand of barley, even though no house had been brought in yet. Next day the house was there, and we found Charles Bolesta planting a strawberry patch alongside it to surprise Eleanor Jane when she came back from a visit to town.

There was Charles Stiles, long, lean, black-haired ex-MP sergeant, fortyish, who already had two 12-foot poplars, pruned down from full-sized trees, growing to shade the house he hadn't had time to start on yet. It was 7 in the morning and he was milking a brindle cow, apologizing for doing this chore where the living room will be. "Those fine trees? One of the old settlers gave them to me; helped haul 'em over. People around here sure are nice and cooperative."

Cooperation—yes, that was what struck you when you saw the full-steam-ahead way the new homesteaders were going—Mr. Stiles' daughter and son-in-law were helping him and Mrs. Stiles get the grassland in shape, a low place filled in, and the house built. Then they in turn would take over Mr. Stiles' dry farm across the hills in Lake County.

Mrs. Lena Johnson had come out from Minnesota to help her son and daughter-in-law get started. She was busy in overalls, calcimining the beaverboard walls of the barracks.

There were five pieces of machinery at work on Gerald Corcoran's place. (See photo on this page.) New homesteaders Bill Crawford, Robert Anderson, and Eldred Charley, brother Myron Corcoran, friend Ed Jones, home on furlough—these five were operating the battery in a coordinated sweep that looked like a California corporate farm instead of 80 acres up at Klamath.

"Everybody trades work and equipment," Mr. Corcoran said. "We figure that if somebody is willing to rent our land for $50-$60 an acre that means he figures he can add that amount to his costs and still make a good profit. Why shouldn't we get that extra money ourselves? All it takes is a little cooperation and we can get the crops in and still get our houses fixed up and everything going fine by the end of the year."

"That's right," said Mrs. Jennie Oman,

Tulelake pioneers live their new lives according to the best traditions of our hard-working, home-loving, community-conscious forefathers.

Photo by Ben D. Glaha, Region II

of Grain"

Photo by J. E. Fluharty, Region II

PINT-SIZED ***Dennis Oman, whose mother, Mrs. Jennie Oman, with the rest of the settlers is building a community for this and future generations.***

looking up from where she was tucking hot caps around her melons. "We can do anything. The oldtimers around here said you can't grow melons. I'll show 'em." The Omans will show 'em, too. They're here to stay. Mr. Oman was tacking up a "For Sale" sign on the house trailer because their place was already liveable. Within a day or two a substantial 30-foot chicken coop, built with salvaged lumber, would be ready to care for a big brood. In addition to the kitchen garden, there was grass and a big plot of flowers.

"Sure we'll show 'em," said Walter Hulse. He had alfalfa in, and a plot ready for potatoes. His barracks had the beginnings of a solid foundation and he was putting in a big picture window to get the fine view south and west. "We have a chance to make it while the making is good. You can do it and still have time to make yourself a nice place to live."

More than likely this bunch will show everybody. Two months after they got their homesteads there were crops growing on every place. Only 15 percent are leasing their land. Nobody is trying to make a million dollars the first year by plunging into potatoes, which take so much work that he wouldn't have time to make a home; but 33 have planted their 17-acre potato allotments. Two-thirds have their whole places in Hannchen, the premium malter's barley that is a profitable Klamath specialty. Perhaps a quarter of this group has clover, grown here for its valuable seed, mixed in with the barley. Twenty-five percent have their land in alfalfa and clover. One or two are raising flax, which looks good this year. When we last saw the project all the crops were up and looked well. In addition, half the homesteaders had their barracks on the land and were ready to move in; almost all the rest had made arrangements to move theirs. About 50 had bought some power farm equipment. This first season there is plenty of work for every piece in the area.

And they are already beginning to form a solid, public-spirited community. The monthly project meetings are teaching them the possibilities for civic action lying in the old New England town meeting. With the help of Paul Braunig, Bureau settlement specialist, the power company was induced to build lines in on a subdivision basis, instead of to individual settlers as they applied—a quicker and cheaper method of getting electricity. They were discussing a bond issue for a water system. Plans were afoot to move a school to a more convenient location. Some were talking of a vocational agricultural school in Tule Lake, using surplus buildings and equipment for classrooms and shops. A committee headed by homesteader Paul Rogers is making Modoc County aware that there are a couple of hundred vigorous young voting citizens up in its northwest corner. The county claims it has no money to build roads on the project; the homesteaders are demanding either roads or the loan of equipment to build roads themselves.

Yes, this is a community that ought to be a successful one. It is carrying on in the best traditions of America's pioneers.

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NEXT MONTH—the story of what is happening in the way of assistance to new veteran settlers on the Minidoka project in Idaho.

Power Shortage

(Continued from page 232)

It is sound national policy to increase the production of public power in connection with Federal multiple purpose water developments because those projects are conservative of our energy resources and provide other lasting and essential benefits to our people.

It is sound national policy to increase the ratio of these public power installations to the total capacity of the country because under the policies that have been laid down by the Congress for their handling they provide an opportunity to develop undeveloped areas and afford a means for consumer protection on price and availability of power.

But as much as we favor the continued development of publicly produced power for the long run, we believe even more strongly that our present task is to add kilowatts to our national capacity and would not think of discouraging any development of additional electrical energy at this time—whether by steam, hydro, or diesel; by cooperatives, private utilities, or by public agencies.

We have reached a point where the necessity for more power production facilities overrides any other consideration.

We hope that the utilities will bend every effort to increase their capacity. At the same time, the work of the Bureau of Reclamation, the Army Corps of Engineers, of Bonneville, of Southwestern, and of TVA is vital to supply the power requirements of our Nation.

We assume that the agreement reached by public and private utilities alike in the Northwest, calling for more and faster Federal power facilities was motivated by a knowledge that this power is essential to the development of this region and the maintenance of its agricultural, commercial, and industrial strength and is basic to the defense of our Nation.

The time has come for others in the utility business, public and private and cooperative, to take a similar responsibility for the economic welfare and the security of our country and its people. ●

The above article was adapted from an address by Mr. Goldschmidt, before the Fifth Annual Convention of the National Rural Electrification Cooperative Association at Spokane, Wash., Wednesday afternoon, April 23, 1947.

UTAH'S "Water Courts"

(Continued from page 233)

whenever he thought his crops needed it? At what point did *use* become *waste?* Out of these and other serious and honest attempts to solve such questions was coined the phrase "duty of water."

It was providential that this experimentation fell to the lot of a cooperatively minded and homogeneous people. In Mormon hands those small 5- and 10-acre fields became in reality experimental farms on which the intricacies of irrigation practice were painstakingly worked out. It simplified the problems to have all families owning about the same amount of land and having, therefore, about the same needs.

Because all of these settlers had minds of their own which they were using, there were many controversies. The ecclesiastical "courts" were frequently called upon to settle some dispute over water. There were no legal precedents applicable to such disputes in this arid region. But the Utah settlers were of the same faith and they respected and obeyed church laws. Church "courts" ruled that taking irrigation water when it was another's turn was an un-Christian act for which one could be tried for his fellowship in the society.

There were two such church tribunals which heard all these grievances, and all of this service was rendered without cost to the parties to the controversy. The bishop's "court" was the "court" of primary jurisdiction. It was composed of a bishop and two counsellors. They heard each case with patience and forbearance and rendered a decision. The decision did not legally bind the parties, but its practical effect was to settle the controversy in a large percentage of the cases. If either party was dissatisfied with the decision, he could appeal to a high council "court" which was composed of a president and 12 high priests chosen for their mature experience, sound judgment, and for their high standing in the confidence of the people. This court had both original and appellate jurisdiction. It heard all the evidence on both sides and sustained the bishop's decision if they thought it just, or modified it if they thought it unjust. Those old trial records shed an illuminating light on the struggles to reduce the practice of irrigation to a workable system. In their broader aspects, the courts were seeking always to discover and lay down rules of general equity that would apply in all cases rather than just the settling of a dispute between this man and that.

Perhaps an actual case or two may be of interest. There was, for example, the case of *Edwards* v. *The People of Paragonah.* William Edwards had a full-day water right in the Paragonah field. He acquired a piece of dry land a mile away from the field and he wanted to transfer his water right to it. He made a ditch and when his water turn came he took the stream away from the field and diverted it to his new farm. He argued that the water was his on that day and he could use it where he pleased.

The farmer whose turn followed Edwards protested. He said it always cost him an hour of his water turn to run the stream down through a dry ditch and the dry ditch also soaked up a lot of his water. Other farmers said they depended on the field ditch to water their work animals and Edwards was, therefore, causing them great inconvenience and loss of time.

The bishop's court decision was that Edwards could not take the water from the field in which it was allocated without injury and loss to all water users in the same canal. Nor could he do so without loss of water to himself since he, too, had to run the stream each week through a dry ditch. Moreover, if Edwards could divert his water, then every other field owner could do the same and soon the value of the old established field would be depreciated. On appeal, the high council confirmed the bishop's decision. Many years later Edwards took his troubles to the civil county court which applied the same reasoning as the church "courts," and rendered a similar decision.

Perhaps the most noteworthy case of all was that of a man we shall call Brother A who went out at night and stole the water off Brother B's grain and put it on his own. In the morning B discovered the theft, followed the stream down, and found it on A's grain. Brother A was convicted of stealing water and the bishop's decision was, "You shall appear next Sunday in church before all your brothers and sisters, confess your sin and ask their forgiveness. Then in the fall the threshers shall measure your grain and determine your yield per acre. They shall do the same also on the field you robbed. Then you shall deliver into Brother B's bin an amount of grain that will make his land yield as much per acre as your land yielded. That will be the amount of grain that the water you stole produced." The culprit proposed instead that he would give Brother B his next full turn of water and that would be double the amount he had stolen. The bishop said, "No, that will not answer the ends of justice. Damage has already been done to Brother B's crop and a belated application of water now will not help that. Then, taking the water off your grain at this time might injure it and both of you will be the losers." "But," reasoned the thief, "your decision puts on me the labor and expense of harvesting his grain and that is not fair." The bishop's reply was worthy of a Solomon, "You borrowed his grain without his consent and now you must return it without his assistance."

How did it all come out? Because the sentence was so unusual, it was on the tongues of everyone throughout the summer and when threshing time came curiosity could scarcely be restrained. To the surprise of all, Brother B's land yielded more grain than Brother A's and the credulous said, "The Lord never prospers a thief." But in the minds of the thinkers the incident stirred a suspicion that possibly they were watering their crops too much. Subsequent experience confirmed that suspicion and the field fence was pushed out to enclose more land which the same stream was made to cover. The average yield per acre under the old system of frequent watering was 25 bushels per acre. When the amount of water was cut, the yield was built up subsequently to double that amount. That one eye-opening case led not only to the doubling of the yield per acre but also to the doubling of the acres farmed under the old canal. (Concluded on page 246)

PACIFIC OCEAN
OKANO
Seattle
W A
CLE ELUM RES
TIETON RES
Yakima
YAKIMA
Portland
BONNEVILLE DAM
(Army Engrs)
Columbia
UMATIL
Salem
DESCHUTES
BUI
OREGON
CRANE PRAIRIE RES
Bend
WICKIUP DAM
WARM
UPPER KLAMATH LAKE
Klamath Falls
KLAMATH
GERBER DAM
CLEAR LAKE RES
SHASTA DAM
Redding
KESWICK DAM
Sacramento R.
ORLAND
Orland
CENTRAL VALLEY
TRUCKEE STORAGE
Reno
BOCA DAM
LAKE TAHOE
Carson City
SACRAMENTO
San Joaquin R.
San Francisco
2
FRIANT
DAM
Fresno
Kings River
PINE FLAT DAM
Kern River
Bakers
LEGEND
AREAS BENEFITED BY PROJE
AREAS SUBJECT TO ULTIMAT
FROM PROJECTS AUTHORIZE
CONSTRUCTION, OR OPERAT
REGION BOUNDARY
3
REGION NUMBER

The Huggins Check Plat

by John K. Black

Shoshone Project, Wyo., Region VI

Photo by Joe W. Buller, Region VI

The author, inspecting pea plants on Huggins plat. Inocculated plants at left. Compare pea pods.

Mother nature gives up her secrets very reluctantly but usually provides a handsome reward to anyone who diligently sets out to improve her domain.

It was general knowledge that Heart Mountain Division lands are deficient in nitrogen, but the extent of this deficiency was not fully appreciated until Alvin J. Huggins, a World War II veteran, on Unit No. 62, set up a check plat in his pea field.

This enterprising homesteader picked out 10 acres of his most level land and seeded it to seed peas for which he had contracted. The field man for the seed company with whom he was dealing advised that the pea seed should be inoculated with nitrogen-fixing bacteria to make sure these necessary little organisms would be there to gather the free nitrogen from the soil air and concentrate it in nodules on the roots of the plants where it could be used in the plant diet.

Huggins, being of a scientific turn of mind, left a check plat about 75 feet wide where no inoculum was used. The results were apparent almost from the day the first plants came up. The check plat produced pale green plants that barely covered the ground. It was easy to see where the seed had been treated. Healthy rugged plants followed the drill marks and showed up in stark contrast to the dwarfed growth in the check plat alongside. And all it cost him was 30 cents per acre for the inoculum.

Now that the peas have been harvested, the results are even more apparent. The check plat was barely worth harvesting. The plants were so short that it was difficult for the combine to pick them up. The acreage treated with bacterial culture produced at the rate of 2,000 pounds of clean peas per acre, while the untreated plat yielded 200 pounds per acre. At the contract price of 7 cents per pound, it is simple arithmetic to figure the reward this veteran received for giving mother nature a helping hand by turning loose in the soil the all-important bacteria.

Land Use Specialist Robert M. Fagerberg prepared a full report on the subject which was given at one of the meetings. The local newspaper also took up the subject in one of its issues. The lesson has been well learned and all will benefit by it another year.

As the settlers began to arrive in March and April of this year, project personnel were called upon to answer a great many questions:

- What crops should we plant?
- When should we plant?
- Where can we get seed?
- Where can we get machinery?

In order that only the soundest advice would be given these young men eager to succeed on their pioneering venture as homesteaders, the county agent, representatives of other agricultural agencies, successful farmers, representatives from seed houses, the canning company, the sugar beet fieldman, machinery dealers, and others who could contribute sound advice, were consulted and invited to attend the settler's meetings held each Thursday evening.

These men would sit together, each explaining his own experiences and inviting questions from the new settlers and other members of the panel.

It was obvious from the first meeting that the experts had the interest of the veterans at heart and were not necessarily trying to promote their own businesses.

A representative from one of the bean elevators advised the boys not to try producing beans until the lands had been built up by applications of barnyard manure or green manure, even though this meant he would get no beans from Heart Mountain this year.

The same was true with the field man from the sugar-beet company.

All of those who were called in drove home the point that it was important to plant sweet clover or alfalfa on the land the first year and to make wise use of irrigation water. These meetings laid the foundation for sound farming practices on Heart Mountain homesteads and can prove equally effective with other groups of settlers.

As a rule, the modern homesteader of today, a veteran of World War II, is young and energetic. He is usually well informed, but more important than this, he has his eyes and ears open and is receptive to suggestions. It is the responsibility of the members of the project settlement and development staff, the county agricultural agent, and other agricultural leaders to see to it that he gets the best possible information, but they too must learn as they go along.

Every new division opened for settlement has its own individuality, and therefore, experimentation must be encouraged. Huggins' experience will certainly encourage other settlers to set aside check plats each year which will assist all the farmers in the area in developing improved agricultural practices.

Trans-Mountain Water—

A Blessing and Challenge

First flow through Adams Tunnel starts era of higher yields of surer crops if water is applied wisely

●

by N. R. McCreery

Consulting Agriculturist, The Great Western Sugar Co.

Drawing by Jas. D. Richardson

Alva B. Adams Tunnel, June 23, 1947, after 14 years of planning and work.

When water flowed through the Alva B. Adams Tunnel to the eastern slope on June 23, 1947, nearly 14 years after the first meeting of the project sponsors in Greeley, August 17, 1933, we could see the first tangible evidence of the fulfillment of a dream of a few far-sighted men.

It was truly a historic event when eastern Colorado was given the opportunity of securing for the present generation the benefits of this increased water supply and, what is of even more importance, the preservation for posterity of the rights to this water in the Colorado River that could only be assured by actually putting the water to beneficial use. Too much credit cannot be given to Mr. Charles Hansen of Greenley, who has been the guiding spirit, the wise counsellor, the persevering genius of conciliation in the face of many perplexing and recurring problems through all these years.

At this time the project is only partially completed, but the additional 40,000 acre-feet of water available to the irrigated land under the Big Thompson Irrigation District and the land tributary to the South Platte River east of the confluence of these two rivers will mean much as a supplemental supply and a veritable godsend in years of deficiency.

Power To Aid Marketing

A few years hence, when the entire project is completed and the total 310,000 acre-feet become available, we can look forward to northern Colorado becoming an even more outstanding agricultural region than it is today. This will mean an increase in the created wealth of the region that will draw and sustain an increased population.

Increased output of farms will bring marketing problems. To some extent these will be solved by new processing plants drawn to the area by more than one hundred thousand kilowatts of electrical energy to be generated annually by the power plants of the project.

In some of the recent dry years our rejoicing would have been more enthusiastic than in this year of more than normal rainfall. But to those who have had the frequent experience of no water for the second and third cuttings of alfalfa or the last two applications for their sugar beets and have seen the yields reduced in both of these crops by several tons per acre, the knowledge of this ample supply of water available for the future will bring pleasant anticipation of increased yields and more stability of income because they can now plan any diversification of crops that offers them the highest return from their land.

We in the beet-sugar industry who have seen the fields drying up after the August 15 irrigation and have known there was no more water in sight will now know that we need not fear the recurrence of this deficiency but instead may expect an increase of several tons per acre through the continued growth of the crop to the harvest time as the result of this late irrigation.

This is certainly a rosy picture and can mean the beginning of a new era in the agriculture of northern Colorado if a careful use is made of the additional water, but an increased water supply is not always on the credit side of the ledger. It is possible that this water can be the cause of reduced yields if it is not used judiciously. In other words, it is possible that an ample supply can prove a detriment rather than a blessing. If too much water is used on the fields, not only do the crops not produce their maximum growth for the current year, but plant food for future crops is dissolved and carried away through leaching, and the crops of future years may suffer.

A reasonably moist condition of the soil is desirable during the growing period of most crops, and especially sugar beets, to keep the plants drawing their maximum supply of the plant food from the soil which is only available to the plant in liquid form.

For sugar beets, frequent light irrigation during the entire growing period will produce more tons per acre than infrequent heavy irrigations. This is not just a case of someone's theory but a proven fact demonstrated many times by experiment stations. The excess water from a heavy irrigation creates a saturated condition that is not conducive to maximum growth during the time that the excess water remains around the plant.

Bad Use of Ample Water Reduces Yields

In addition to the loss caused by retarding the growth of the crop, there may also be a slowing of the bacterial action in the soil due to the cold, damp condition maintained over substantial periods of time while the excess water is percolating out of the soil. The maintenance of this cold, damp condition due to over-saturation also tends toward a compacting of the soil and a certain loss of the tilth that is necessary to encourage maximum plant growth.

Further, some areas will become seeped from the surplus water, increasing the necessity of drainage installations to bring the land back to a usable condition. Harmful effects from too much water are multiplied with the years and it is well to be aware of the problems which may arise from the increased water supply in order to avoid the damages that will surely follow its excessive use.

(Continued on page 248)

Ditchbank Weed Control in the Southwest

by Curtis Bowser

Region III, Boulder City, Nevada

Weeds long have been recognized as one of the important forces responsible for serious losses in the production and marketing of crops.

It is known that infestations may be started from weed seeds maturing on ditchbanks and carried to farms by the irrigation water. Also weed growth on the ditches create one of the major operating problems for irrigation districts because they impede the flow of water, cause seepage, and transpire enormous quantities of water.

The Bureau of Reclamation has realized the seriousness of these problems and has instigated a weed control program designed to help prevent this source of infestation to crop land and to reduce operation problems and maintenance costs created by weeds growing on ditchbanks. (See March 1947, RECLAMATION ERA, p. 55, for the story on ditchbank pasturing.)

The favorable growing conditions in the Southwest which are well known for year-round production of fruits and vegetables are equally as favorable for the growth of weeds. Irrigation projects in this area are plagued with a year-round problem of controlling undesirable plants along the irrigation systems.

The recent strides in chemical weed-control research have shown that weeds no longer need be regarded as a necessary nuisance. Now many effective methods can be economically employed to reduce the heavy tax which these pests impose upon agriculture.

In the Salt River Valley, Ariz., the most troublesome weed is Johnson grass, a rank-growing, comparatively shallow-rooted perennial plant, often attaining the height of five or more feet and sometimes completely covering a ditchbank and right-of-way.

Up until 1945, the weed-conscious water users in the Salt River area employed mobile weed burning units to control the ditchbank plants. However, the success of this operation was generally poor as some ditches did not have operating roads, and the fire hazard to the many haystacks, buildings, trees, grain fields, and telephone and power poles near the canal right-of-ways was not conducive to the use of large, high-pressure weed burner units which are necessary if efficient and economical burning is to be accomplished. Neither was it possible always to perform the burning operations as frequently as is necessary to eradicate Johnson grass.

Consequently, experiments with oil spraying were made, and it was found that Diesel fuel oil, when applied in quantity to cover the vegetation, would control the Johnson Grass and the noxious broad-leaved plants, yet not seriously retard the growth and spread of the lower growing Bermuda grass which is important as a soil stabilizing and weed competing sod cover in the Southwest.

Photo By C. W. Bowser, Region III

OIL SPRAYING ***in Salt River Valley to control Johnson grass on irrigation ditchbanks. Fences, power lines, etc., prohibit use of large weed burners.***

In 1946, the 12 spray units operated by the Salt River Valley Water Users' Association, were used to apply oil to some 3,200 miles of ditch at an average cost of $20.70 per mile. Approximately 125 gallons of oil per mile were applied, that is, for a strip 8 to 10 feet in width. The costs of application and volume of oil applied are less this season and will be further reduced as the grass and weed infestations are diminished in size and growing-vigor.

The increased cost of Diesel oil and the recent practice of removing more of the aromatic compounds—the most toxic factions to plants—in order to make it a more efficient engine fuel have forced investigators to seek cheaper and move toxic oil substitutes to control grassy vegetation.

Mr. L. S. Evans, associate agronomist of the Bureau of Plant Industry, Soils, and Agricultural Engineering, in charge of the Southwestern Federal Weed Research Station at Phoenix, Ariz., has been working on irrigation weed problems in cooperation with the Bureau of Reclamation and the Salt River Project.

He has investigated a mixture of fortified oils and water, i. e., 70 gallons of water, 30 gallons of oil, and 1 quart of phenol fortifier (Dow General, Sinox General, or Chipman General) on ditchbank weeds.

Initial results indicate this nonselective spray will destroy very rapidly the parts of the plants above ground and that the regrowth will be slower and have less vigor than when the weeds are sprayed with straight undiluted oil.

In addition to being more toxic, the fortified oil and water mix is less than one-half as expensive as the 27°+gravity oil commonly used for ditchbank weed spraying. Test applications of high aromatic unsaturated oil compounds (Shell Weed Killer No. 20 and Standard Weed Killer No. 2) on Johnson grass and Carrizo cane also have proved highly successful.

The weed-control problems confronting the operation and maintenance forces of the Yuma and All-American Canal projects in southwestern Arizona and the Imperial Irrigation District in Southern California present different aspects than those in the Salt River Valley.

There the objectionable ditchbank weeds are predominantly shrubby species, arrowweeds, salt cedars, and willows. Also, the ditchbanks have different characteristics from those in the Salt River Valley—they are wide with operating roads on both sides and few houses, fences, or haystacks near the right-of-ways. These are ideal operating conditions for large-size, truck-mounted weed-burning equipment.

The Imperial irrigation district, which incidentally is at present the largest irrigated area under one district in the United States, practices a successful weed control program and other weed preventative measures on its 3,000 miles of irrigation waterways.

In 1946, with 11 weed burners, the District covered a total of 23,779 miles of ditchbank, some sections of the 3,000 miles receiving several applications, consuming 2,059,244 gallons of burner fuel. The average cost per mile for all weed burning was $10.59.

There are now but few large weeds growing along the inside ditchbank slope. The secret of the Imperial irrigation district's economical weed burning is the far-sighted scheduling and timely execution of the weed-burning operations so that the plant

Photo by Samuel B. Watkins

TRUCK-MOUNTED WEED BURNER *operating along Gila Gravity Main Canal in Arizona.*

Photo by Harry W. Myers, Region III

WEED BURNING UNIT *operated by Imperial irrigation district in area free of fire hazards.*

growth never gets out of control.

To remove the water-line weed infestation from the All-American Canal, it was necessary for the Bureau of Reclamation maintenance force to resort to equipment that could approach the weed growth from the water surface, as in many places ditchbank operating roads are not provided and in other sections of this giant-sized canal the banks are of such height that a 45-foot boom on a truck-mounted burner could not reach the water line.

Consequently, a weed-burner unit was mounted upon an amphibious DUKW, 2½-ton GMC vehicle, and canal bank ramps were constructed to provide means for entry and exit for the equipment.

The flame sweeping up and through the vegetation on the ditchbank slopes was so effective and the operation with the amphibious unit so successful that the Bureau since has obtained several DUKW vehicles to be used in those waterways of sufficient depth and size to allow free movement of the machine.

(EDITOR'S NOTE: Construction details of the amphibious weed burner were featured in the October 1946 issue of the RECLAMATION ERA. Complete detail design drawings of either the truck or amphibious mounted weed burners will be furnished on request from regional director, Region 3, Boulder City, Nev.)

More economical and efficient measures to eradicate the undesirable ditchbank weeds now are being investigated.

Trials in 1946 indicated that 2,4-Dichlorophenoxyacetic acid possibly could be used to control the broad-leaved plants, including among others the willows, salt cedars, and arrow-weeds.

The results of the 2,4-D applications this season to some 250 miles of canal bank vegetation by the Bureau of Reclamation and the imperial irrigation district have been 100 percent satisfactory, and no harmful effect to field crops has resulted.

Care and caution are exercised when applying 2,4-D to ditchbank weeds and the practice is followed of not spraying in areas where possible harmful effects to susceptible crops, including cotton and tomatoes, could result. Note picture below showing the application of 2,4-D to a heavily weed-infested outside ditchbank slope.

Cost of the 2,4–D applications compares favorably with the cost of burning; also the spraying is preferred, as the workmen are not exposed to the uncomfortable heat and smoke nor is there a fire hazard. Further, the 2,4–D eradicates the weeds in a comparatively short time while burning may require many operations over a period of several years to effect a kill.

The grassy weeds, however, are not affected by the 2,4–D. For these plants other means such as frequent burning, the use of fortified and aromatic unsaturated oils, and improved herbicides must be used.

The 1947 season has been most successful in the history of weed control on irrigation ditches. The new and more scientific methods introduced show promise of saving irrigation districts hundreds of thousands of dollars annually in addition to more effectively preventing weed infestations on farm lands. However, many other methods are being investigated to obtain even greater efficiency in ditchbank weed control in the Southwest and other regions in the reclamation area. ●

AMPHIBIOUS TACTICS *are employed in All-American Canal area where it is impossible to get at weeds by land. This DUKW will "smoke 'em out."*

Photos by Harry W. Myers, Region III

APPLYING 2,4–D *to vegetation on outside of ditchbank in Southern California. Spray is applied under high pressure but is controlled and directed to give full plant coverage.*

Getting the Sub Up

Subirrigation in the San Luis Valley of Colorado dominates the agriculture, the social life, and the vernacular of the region

by Frank A. Brookshier

Former Project Economist, San Luis Valley Project, Colorado

The "sub" was just right and resulted in this big potato harvest.

"I've sure got the sub up!"

A son of the soil pulls out his bandanna, wipes his brow, and with these words identifies himself as a practitioner of the agricultural art known as "sub culture" or "subirrigation," a dominating characteristic of the fertile San Luis Valley of Colorado.

This unique, practically level valley plain, averaging a mile and a half above sea level, is virtually a closed basin, surrounded by colorful mountain ranges. To the south and southwest are the San Luis hills. The San Juan, in the west, merges in the north with the lofty, legendary Sangre de Cristo Range which, pushing up from the south, ushers the blood-red sun into the enclosed valley.

The valley is traversed by the historic, winding Rio Grande that meanders on through New Mexico to draw an irregular line between Texas and Mexico before mixing its waters with the Gulf, 1,800 miles from its source.

At one time the valley was covered by a huge lake supplied with water from the Rio Grande River. But as the channel of the river cut deeper and deeper into the rocky canyon to the south of the valley, the lake was eventually drained, leaving an underground basin of water that stands at a level of approximately three feet under the surface. This underground lake, below the roots of the growing plants, makes subirrigation possible. The water table is raised or lowered by diverting waters from the Rio Grande river out over the smooth surface of the valley floor.

"Can't get the sub up," is an expression heard on farms during a dry spring or summer. It means the water table is too low, that is, too far below the surface of the ground, and even though an effort has made to recharge the ground-water area, the moisture is not moving by capillary action into the root zone.

The water table rarely exceeds 10 feet except on steep, alluvial slopes, and fans near the outer edge of the valley. This shallow ground water is stored in a porous fill ranging in depth from 10 to 90 feet over a floor composed mainly of silts, clays, sands, and gravel.

Whether the farmer can get the "sub up" may and often does determine the difference between a successful and an unsuccessful farming season. This factor is important in an area where the annual rainfall averages only 6 to 9 inches, and the growing period is short. However, once in a great while the amount of rainfall exceeds the normal, and then one will hear the complaint: "Can't get the sub down." Even though the season is dry, a few sudden rains, supplementing the irrigation water, will get the sub up too high in some areas and this condition may prevail during potato spraying. If so, the tractor-sprayer may bog and give the potato bugs a chance for a Roman holiday. Not only tractors, but wagons, automobiles, and all vehicles bog down to their hub-caps while the "sub is up."

The sub culture in the San Luis Valley dates from the middle of the nineteenth century when the first permanent agricultural settlements were established in the lower section. The soil structure, grade, and water table encouraged the practice of subirrigation.

The common method of subirrigating is by cutting small ditches through a field, the direction corresponding with the slope or grade of the land. The distance between these laterals varies from 100 to 300 feet, depending on the structure of the soil, water available, crop grown, and similar factors. Normally about one-fourth to one-half cubic foot of water per second is run down the ditches. Checks of dirt, which serve to retard the flow down the laterals and cause the water to seep out below the surface of the field to build up the sub, are placed at frequent intervals in the ditches. A network of covered and open drains prevents accumulation of excessive salts in the soil. These drains serve a dual purpose during dry periods; farmers place checks in them to hold up the sub, and recharge the ground water areas. Eventually some of the water returns to the river, or as in the farming area north of Monte Vista, the drains terminate in the closed basin where the San Luis lakes are replenished. Unless neighboring farms correlate their operations, some clashes may result, for the water table is unconfined, and when one man wants the sub up, another may want it down.

Efficient farmers often maintain test holes on their farms to detect quickly the rise and fall of this pulse of the soil's life blood, producing crops to sustain the valley's economy.

A new device known as the piezometer is being perfected, which can be thrust into the ground to measure the moisture content of the soil. It should be popular with valley farmers seeking the "sub."

About 456,000 or 70 percent of the total irrigated acreage of the valley lies in the project area of the Bureau of Reclamation which plans to provide supplemental irrigation water to stabilize its agricultural economy.

Subirrigation is practiced on about half of the farming area each year. This does not necessarily mean that the same plot on a farm is irrigated each year. The crop grown, depth of water table, amount of rainfall, soil structure—all affect the farmer's decision as to his choice of row, corrugated, flood, or subirrigation method for his land. The latter method of applying water to the land has been known for centuries. However, it has been practiced in only a relatively few areas in the United States other than in the San Luis Valley.

Advocates of subirrigation say this method possesses several advantages over

(Continued on page 248)

RECLAMATION MERRY-GO-ROUND

(Continued from page 236)

Reclamationists. The Bureau has advised the chairman of the Public Lands Committee that its passage would advance reclamation.

Family-Sized Farms

The other major legislative controversy in the past session was over an attempt to repeal for three projects the so-called 160-acre law and family-sized farm principle, which has been a cornerstone of reclamation policy since reclamation became a Federal function nearly half a century ago.

That bill was not reported out of committee.

While differences of opinion may be inherent to our democratic process, on these two subjects we are reaching a point where it appears to the detriment of our common interest that so many people spend so much effort and money on these two endeavors each year. They have not succeeded, but they have exhausted a lot of Reclamation's time which could be better spent in driving forward the work you want done and which needs to be done.

Construction Hurdles Ahead

And that leads us to immediate major problems with which we are today confronted. Most of you have had some personal experience in the last couple of years in some type of construction, building a barn or remodeling a house or trying to buy and install a piece of machinery. You know what you were up against. Multiply it a few million-fold and then add all the actions required of irrigation districts, States, and courts that precede irrigation construction, and you know somewhat of Reclamation's task.

Within two days after appropriations were passed in July, Reclamation forces gathered in Salt Lake City to program our work in accordance with the expressed policy of Congress, namely to drive its construction on an all-out basis, giving that requirement the priority over all other endeavor. We are going to use the Nation's money just as economically, effectively, and efficiently as we can for the purposes that you and the Congress provided it. To achieve this end requires a minimum economical rate of construction and not dragging out jobs without finishing them.

To achieve the construction program we will have to surmount a thousand difficulties in a thousand places. In just a few instances it will bring a problem back before you and the Congress. An economical construction program will probably mean, for example, that the great Grand Coulee-Columbia Basin project, the Colorado-Big Thompson project, and the Davis Dam project will go broke, as far as available construction funds are concerned, well before the end of the fiscal year. Some other projects may come into the same dilemma if contractors meet their schedules. Before that time comes we will report the situation to Congress and ask for such appropriations as may be required. Congress will then have before it the question of closing down those approved projects or continuing their construction without interruption.

We believe that is the intent of the Congress and just what it wants us to do. No deficiencies have or will be made by the Congress. We know the cost of closing projects because we were required to do so in war years. But it is unjustifiable waste that increases total costs eventually to be repaid by water users to deliberately slow down construction so that it drags on with continuing nonproductive overhead. The benefits in the form of water and power would be denied to the extent of such a willful slowdown just as repayment would also be denied the Government.

Year's Record Decisive

This has been a decisive year for Reclamation. We have opened 40,607 acres of irrigated public land on 10 projects for settlement by veterans.

Our projects with good times have done better than in the past in meeting their financial obligations. Some delinquencies have been cured, and the record today shows that 97.6 percent of payments due have been made on time. The Bureau honors the good faith of the number of communities which voluntarily increased their payment contracts to accord with increased costs. But, as a practical point, Congress honors that type of partnership when project appropriation time comes around.

The present law requires full repayment without interest of the Federal investment in irrigation within 40 years with a discretionary additional 10-year development period.

The general practice in both private and public financing since the 40-year limitation was written has been to allow longer periods of repayment with full repayment still required but smaller annual payments, within the irrigators' ability to earn, stretched out over a lengthier period.

The Congress itself has been recognizing this situation with increasing frequency in the past few years, and in the last few months has passed individual acts approving specific Reclamation projects with up to 68- and 69-year interest-free repayment periods. A proposal certainly will be made in the next session of Congress to extend the repayment period up to 70 years without a development period. The Bureau will favor that proposal. If Congress approves, this will be another stride forward in our program of liberalization of the reclamation laws and bringing them up to date.

Those are our hopes. But to achieve all these things, reclamation must get off the merry-go-round of a "giddap and whoa" schedule.

While it is inevitable that each shift in the world kaleidoscope reflects on Reclamation and that each Congress, by appropriate action, refixes Reclamation schedules in the light of its latest estimate of comparative needs, reclamation must win for itself a minimum firm program base that the West can rely upon in scheduling its work intelligently at least 6 years in advance.

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Precast Canal Linings

(Continued from page 234)

were placed in transverse rows along the length of the canal. In placing the smaller blocks it was found more desirable to round the canal bottom to obtain the optimum support for the interlocking joints of these blocks.

The conclusions reached as a result of this experiment in the lower cost canal-lining program may be summed up as follows:

1. Precast blocks of these types require a much more exact subgrade than some other types of linings.
2. It will be necessary to use special curved blocks or some other type of lining in curved sections of canals.
3. The precast block lining presents a firm surface of suitable hydraulic properties and is apparently resistant to weed damage and erosion.
4. The scale of this experiment did not permit satisfactory cost conclusions to be drawn. •

Twenty-Three Years Ago . . .

FACT FINDERS SAID: The Reclamation Record, now the New Reclamation Era, should adopt a more definite policy of being a practical aid to the farmer and should be made the most attractive and valuable journal entering the homes of the water users.

From A Report submitted to the Secretary of the Interior by the Committee of Special Advisers on Reclamation, April 21, 1924.

Fort Peck Generator

The Office of the Commissioner of Reclamation is making a strong justification to the Chief of Engineers to support the installation of the third generating unit in the Fort Peck power plant. The additional power is required to meet both present and immediate future power needs of the area.

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UTAH'S "Water Courts"

(Continued from page 240)

It was as late as 1880 before Utah passed a general territorial irrigation statute. The principle of beneficial use and other fundamental principles of water law which developed from custom and necessity in the Mormon communities and elsewhere in the arid West were included in the early statutes, and are still the basis of the State law.

Coachella Contract Draft OK'd

On September 5, Assistant Secretary Warne approved the draft of the Coachella Valley County water district repayment contract for the distribution system and appurtenant flood-protective works. The draft has now been returned to the district for execution. The contract will provide for carrying to completion the Main (All-American) Canal to the Coachella Valley which will result in the total irrigation of 75,000 acres of land instead of 20,000 now irrigated by a pumping system.

Large Dams Conference Papers Requested

The United States Committee on Large Dams, of which Commissioner Michael W. Straus is Chairman, has announced the subjects of the technical papers for discussion at the Third International Conference on Large Dams, to be held at Stockholm, Sweden, from June 10 through 17, 1948. The following papers were announced during the executive meeting of the International Commission at the Hague early in September:

- Uplift on dams and uplift stresses.
- Research instrumentation and results in measuring stresses and strains in concrete and earth dams.
- Methods of controlling piping in earth dams.
- Experience resulting from the testing and use of special cements in large structures.

Engineers are requested to submit their papers through Chairman Straus and are urged to do so by the earliest possible date, but in no instance later than December 1, 1947.

John C. Page Retires From Reclamation Duty

After 36 years of western reclamation service, John C. Page, 60, engineer and onetime Commissioner of Reclamation, will retire from the Federal service on October 31.

In approving the request for retirement, Commissioner of Reclamation Michael W. Straus asked Mr. Page to serve as consultant from time to time on reclamation problems, and added: "It will be most gratifying to me and to other members of the staff to be able to profit from your counsel."

Mr. Page indicated that he would serve when called upon as consultant. Since August 1943, he has been a full-time consulting engineer at Denver, and has worked in part on completion of the Colorado River Basin Report and on preliminary studies of the Central Arizona project.

He served as Commissioner of Reclamation from January 1937 until June 1943, when he resigned upon advice of his physician because of ill health. After a rest, he resumed active duty as consulting engineer.

"The service Mr. Page has given to Reclamation has been marked by a deep love of the West and conscientious interest in development and reclamation of land and water resources there," Mr. Straus said. "His career, which took Mr. Page from surveyman to Commissioner, coincides with all but the first 9 years of the history of Federal reclamation. He has grown with the Bureau of Reclamation, and has contributed in a conspicuous way to the development of our western resources. I am happy that we will not completely lose his experience and knowledge by his retirement from active service."

During his term as Commissioner, the Bureau of Reclamation was engaged in a large construction and development program which added thousands of acres to irrigated farm lands and witnessed the construction of some of the largest reclamation hydroelectric power plants. Among important construction was the construction of Grand Coulee Dam in the Columbia Basin, which during the war was a fundamental factor in the Pacific Northwest's war production, the completion of Imperial and Parker Dams on the Colorado River, the Bartlett Dam in Arizona, the Seminoe and Alcova Dams in Wyoming, Alamogordo and Caballo Dams in New Mexico, and Marshall Ford Dam in Texas. Studies which ultimately led to congressional authorization of the Missouri Basin project were started.

During the early war years, he was engaged in accelerating the aspects of reclamation projects vital to munitions production and maintenance of the food supply. The strain was such that with health impaired, he felt compelled to resign.

Basic Magnesium Power Supply

The Senate War Investigating Committee held hearings at Las Vegas, Nev., on August 21 and 22 to attempt to develop a power supply to keep the facilities in operation.

It was pointed out that the Boulder Canyon power contracts contained restrictions that made delivery from the Hoover Dam power plant exceedingly difficult. Senator George W. Malone of Nevada suggested installation of an extra generator at Hoover Dam and use of the Davis Dam power plant.

The State of Nevada has proposed taking over the facilities at Basic Magnesium including 230-kilovolt transmission and bus structures and three banks of 75,000-kilovolt-ampere transformers. Senator Malone urged that the facilities be turned over to the Bureau of Reclamation instead and all power-supply arrangements made with that agency.

Intensified Canal-Lining Program

Procedures for an energetic attack on canal-lining problems over a broader front, were approved by Commissioner Straus, September 17.

The Bureau of Reclamation has been conducting surveys and research as to low-cost canal linings, and during fiscal year 1948 greater emphasis will be placed on the problems of the smaller canals and laterals with more test sections on operating projects and greater participation by field personnel.

The regional programs and the recommendations of the Chief Engineer provide for an estimated expenditure totalling $355,600. The 1947 allotments for canal-lining work amounted to $650,000 but less than $250,000 of these funds were obligated by the end of the fiscal year.

The program will be coordinated by the Branch of Operation and Maintenance in cooperation with the Chief Engineer.

An intensified approach to many of the problems encountered on the older operating projects is growing in importance in view of the anticipated rise of similar problems on many new projects, particularly in the Missouri Basin. During fiscal year 1947 noteworthy equipment for placing sections of plastic soil cement lining was developed on the W. C. Austin project, and a rotary packer on the Gila project.

It is expected that fiscal year 1948 will see study and testing of vibratory impact equipment, seepage measurement devices, Bentonites and soils, asphalt membranes and asphaltic concrete, soil cement, pneumatically applied mortars, nonreinforced Portland cement concrete, hydraulic lime concrete, precast concrete blocks, and various plastics.

Engineers Needed!

In order to keep western reclamation work rolling at the pace prescribed by the Congress, the Bureau of Reclamation needs more engineers.

Men who are trained and experienced in the design of dams, irrigation canals, powerplants, transmission lines and equipment, roads, railroads, bridges, steel and concrete structures and drainage works, are urged to submit applications for Federal employment (Form 57) to the Chief, Personnel Field Office, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Engineers are needed in the office of the Chief Engineer in Denver and in 29 field design offices throughout the 17 Western States. Chief Engineer Walker R. Young states that through the facilities of the Branch of Design and Construction at Denver he can offer young engineers an opportunity to learn the principles and practices of reclamation engineering and a chance for a worthwhile career in the Federal Government.

These engineering positions pay from $2,644.80 to $4,149.60 to start. While working and contributing to the success of the current program, each engineer is given the opportunity to specialize and to learn the broad objectives of reclamation work for future promotion.

Throughout the Missouri River Basin field engineers are needed. Thirteen new dams are now being started, 4 others are under construction. On these projects, located in the States of Montana, Wyoming, North Dakota, South Dakota, Colorado, Nebraska, and Kansas, field engineers can apply their theory and knowledge to actual construction. The work is hard and the living conditions for families are temporary in some cases, but there is opportunity for engineers to get the practical experience they need in order to qualify for the better positions that lie ahead for those who win their way up the ladder of success.

Those desiring to work on the Missouri River Basin project should send their applications directly to the Regional Director, Region 6, Billings, Mont., and to the Regional Director, Region 7, Customhouse, Denver, Colo.

People who possess civil service status and are eligible for reinstatement may be given permanent appointments. Those who are presently employed by the Federal Government may be transferred at Government expense, provided the transfer is not for the convenience of the employee. Those who do not possess civil service status should apply to the Central Board of United States Civil Service Examiners, Bureau of Reclamation, Denver Federal Center, Denver, Colo., for information concerning civil service examinations. At the present time, temporary appointments pending establishment of civil service registers, are being given to engineers who will have to pass civil service examinations subsequently.

If you are an engineer and you would like to take part in the design and construction of western reclamation projects, send your application for Federal employment to the above-mentioned officials or to the Personnel Field Office, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Transmountain Water

(Continued from page 242)

With this increased amount of water becoming available, the principle limiting factor in maximum crop production will be the fertility of the soil. The present generation will be judged not so much by the construction of this project as by the use that is made of the water and the condition of the land we hand on to posterity.

This increased supply of water from the western slope was intended to supplement the limited quantity from the regular stream flow. If this conception of its use is carried out, it will fulfill the hopes of its sponsors and bring the returns necessary for the liquidation of its enormous cost. Only by such intelligent use can we keep faith with those who have conceived this gigantic enterprise and carried it through successfully.

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The above article was reprinted from the July–August issue of "Through the Leaves" with the kind permission of the publishers, the Great Western Sugar Co., Denver, Colo.

The largest hydroelectric generators in the world are located in the Bureau's power-house at Grand Coulee Dam, Wash. These generators have a capacity of 108,000 kilowatts.

Getting the Sub Up

(Continued from page 245)

the other practices because there is less water lost by evaporation, there is relatively no loss of plant nutrients such as occurs in the more pervious soils when flooded, and labor costs are lower.

The sub culture permeates all phases of valley life, even that gala event, the Ski-Hi Stampede, held annually at Monte Vista. During 3 crowded days of festivities, highlighted by a rodeo, the sub really rises! "My hoss shore's got the sub up!" says a cowboy as he swings off his sweating horse.

A farmer meets his neighbor and asks "How's the sub this morning?" The reply may be, "Well, I'm having trouble with that south eighty. I have been pourin' water into it but don't seem able to get the sub up."

It is a common topic around the dinner table, on country roads, along streets in towns, during farm meetings, and at social affairs. The use of this word (it is no longer just a prefix in this locality), with all of its attendant significance, has produced a common denominator in the lives, speech, and thinking of the valley farmers.

Thus the subirrigation practice is carried over into the various aspects of life in the San Luis Valley and has become a definite part of its cultural pattern. •

OKLAHOMA

Short-Grass Salvation

In the short-grass country of southwest Oklahoma, the normal pattern of weather is a cruel one for farmers: too much rain at spring-planting time, drought in the growing season, rain again for the harvest. Year after year, cotton, maize and alfalfa crops have either been washed out by floods or ruinously parched.

This year's weather was as bad as any since the Dust Bowl days of the '30s. No rain had fallen, to speak of, all summer. But last week, instead of gloom, there was jubilation in the short-grass country. A $12,000,000 Federal Reclamation project was formally opened, promising an end, at last, to floods and drought for 50,000 acres of prairie farmland.

At Altus (population 8,593), the seat of Jackson County, there were 3 days of festivities—a banquet, parades, fireworks. The big event was dedication of a new 100-foot dam across the North Fork of the famed Red River.

On Dedication Day the temperature stood at 110° in the shade—and all the shade the crowd had was a few parasols and newspapers. Visiting bigwigs—including Interior Secretary "Cap" Krug and Gov. Roy Turner—were little better off under the sheet-iron roofing of their bunting-decked stand.

But to short-grass farmers, enduring the heat and 2 hours of speechmaking was no great price to pay for the spectacle before their eyes. Above the dam lay a turquoise lake. Below it, through a creek-bed ordinarily dry at this time of year, tumbled a stream of water, enough to feed 340 miles of irrigation canals and ditches.

What this water meant, the farmers had already learned. Last year, 510 acres on 11 farms were irrigated. Their average return, mainly from cotton, was $130 an acre, versus $22 an acre for nonirrigated land. This year, 3,200 acres on 60 farms have been irrigated. On these lands, cotton now stood 5 feet high and loaded with bolls. On nonirrigated land, it was only 2 feet high and barely worth picking.

Secretary Krug voiced the obvious moral: a nation which is endeavoring to rehabilitate the world could use more reclamation projects like the one at Altus.

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The above article was reprinted from TIME *magazine, September 15, 1947, with the kind permission of the publishers.*

U. S. GOVERNMENT PRINTING OFFICE: 1947

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Sir: Please send certificate and the Reclamation Era for ____ year(s) to:

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NOTES FOR CONTRACTORS

Contracts Awarded During September 1947

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1842	Missouri Basin—Kortes, Wyo	Sept. 4	Control board for Kortes power plant, schedule 1	General Electric Co., Denver, Colo	$34,964.00
1842	do	Sept. 5	One a. c. distribution board, 1 d. c. control and distribution board, and 2 motor-generator sets for Kortes power plant, schedule 2.	Zinsco Electrical Products, Los Angeles, Calif	17,089.00
1842	do	Sept. 12	Two 750/935 kilovolt-ampere transformers for Kortes power plant	Standard Transformer Co., Warren, Ohio	13,614.00
1848	Columbia Basin, Wash	Sept. 19	One 6,000/7,500 kilovolt-ampere transformer for Grand Coulee power plant.	do	23,624.00
1854	Boise, Idaho	Sept. 15	Two butterfly valves for Anderson ranch power plant	Baldwin Locomotive Works, Eddystone, Pa	94,100.00
1866	Missouri Basin—Kortes, Wyo	Sept. 2	Three ring-follower gates with hydraulic hoists, gate hangers for Kortes power plant, item 1.	Willamette Iron & Steel Co., Portland, Oreg	131,066.00
1866	do	Sept. 2	Three controls for ring-follower gates for Kortes power plant, item 2	Vickers, Inc., Detroit, Mich	11,472.00
1868	Columbia Basin, Wash	Sept. 15	Nine 83,000 kilovolt-ampere transformers for Grand Coulee power plant, units R1, R2, and R3, schedule 1.	Westinghouse Electric Corp., Denver, Colo	931,970.00
1872	Deschutes, Oreg	do	One 15-ton revolving crane for Wickiup Dam outlet works	Marin Crane & Hoist Co., Philadelphia, Pa	10,116.00
1875	Columbia Basin, Wash	Sept. 8	Replacement parts for circuit breakers, and current transformers for Grand Coulee switchyard.	General Electric Co., Denver, Colo	89,700.00
1879	Davis Dam, Ariz.-Nev	Sept. 22	Transformers and circuit breakers for Phoenix substation, schedules 1 and 3.	do	297,726.00
1879	do	do	Disconnecting switches and lightning arresters for Phoenix substation, schedules 4 and 5.	Westinghouse Electric Corp., Denver, Colo	20,300.41
1881	Missouri Basin—power transmission lines unit, Nebraska.	Sept. 12	Three 3,333 kilovolt-ampere transformers for Gering substation, schedule 1.	do	59,468.00
1881	do	do	Circuit breakers and current transformers for Gering substation, schedules 2 and 4.	Allis-Chalmers Mfg. Co., Denver, Colo	66,375.80
1881	do	do	Disconnecting switches for Gering substation, schedule 3	Electric Power Equipment	31,737.63
1888	Boulder Canyon, Nev	Sept. 2	Construction of streets, sidewalks, curbs, and gutters for Boulder City	Queen & Queen and J. E. Roberts, San Bernardino, Calif.	51,731.00
1889	Kendrick, Wyo	Sept. 17	Four 5,000 kilovolt-ampere transformers for Cheyenne substation, schedule 1.	Westinghouse Electric Corp., Denver, Colo	86,872.00
1889	do	do	One 15,000 kilovolt-ampere transformer, 15 current and 2 potential transformers, for Cheyenne substation, schedules 2 and 7.	Allis-Chalmers Mfg. Co., Denver, Colo	29,755.28
1889	do	Sept. 10	Circuit breaker for Cheyenne substation, schedule 3	General Electric Co., Denver, Colo	22,818.00
1889	do	Sept. 26	Disconnecting switches for Cheyenne and Casper substations, schedules 4, 5, and 6.	Railway & Industrial Engineering Co., Greensburg, Pa.	12,712.48
1893	Davis Dam, Ariz. Nev	Sept. 4	Disconnecting switches for Tucson and Phoenix substations, schedules 1, 2, and 3.	General Electric Co., Denver, Colo	41,739.19
1894	Boise-Payette, Idaho	Sept. 15	Outlet pipe for Cascade Dam outlet works	Independent Iron Works, Oakland, Calif	11,391.00
1895	Rio Grande, N. Mex	Sept. 17	Lightning arresters, demand meters, watt-hour meters for Alamogordo and Hollywood substations, schedules 1, 3, and 5.	General Electric Co., Denver, Colo	84,196.00
1899	W. C. Austin, Okla	Sept. 16	Construction of earthwork and structures for Altus laterals 21.5 and 21.7 and sublaterals.	Stamey Construction Co., Altus, Okla	430,165.00
1904	Davis Dam, Ariz. Nev	Sept. 17	30,000 tons of calcined, reactive, siliceous material for use in concrete	California Portland Cement Co., Los Angeles	330,000.00
1906	Provo River, Utah	Sept. 26	Welded-plate-steel siphon, pen stock, discharge pipe and blow-off pipe for Jordan Narrows pumping plant and siphons.	Provo Foundry and Machine Co., Provo, Utah	117,712.25
1907	Shoshone Heart Mountain, Wyo.	do	Construction of earthwork and structures for Ralston lateral, station 231+25.02 to 413+69.25, laterals R1 to R-15-11 and R-26 to R-41 and sublaterals; north alkali drain.	Knowlton and Jensen, Salt Lake City, Utah	354,978.00
1919	do	Sept. 30	Steel structures for switchyard at Heart Mountain power plant	Independent Iron Works, Oakland, Calif	10,134.00
1920	Missouri Basin Canyon Ferry, Mont.	Sept. 16	Construction of earthwork, structures, and surfacing for relocation of county roads at Canyon Ferry Dam.	Union Construction Co., Great Falls, Mont	202,039.50
1925	Missouri Basin Kortes, Wyo	Sept. 19	Electrical equipment for Kortes power plant	General Electric Co., Denver, Colo	14,593.50

Construction and Supplies for Which Bids Will Be Invited During November 1947

Project	Description of work or material
Boise-Payette, Idaho	Construction of earthwork and structures for Sand Hollow wasteway.
Do	Construction of earthwork and structures for Willow Creek wasteway.
Boise, Idaho	Generator protective equipment for Anderson Ranch Dam power plant.
Boulder Canyon, Nev	Furnishing and installing 6 miles of 12- and 14-inch diameter high-pressure steel pipe, and erection of 50,000 and 2,000,000-gallon storage tanks near Boulder City.
Central Valley, Calif	Construction of earthwork, lining, and structures for 14.5 miles of Friant-Kern Canal.
Do	Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.
Do	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Do	Oil circuit breakers, disconnecting switches, instrument transformers, lightning arresters for Tracy switchyard and Elverta substation.
Boulder Canyon-All-American Canal, Calif	Construction of structures for distribution systems in East Thermal and North Indio areas, Coachella Division.
Do	Construction of wasteways Nos. 2 and 3 for flood protective works, Coachella Division.
Colorado—Big Thompson, Colo	Construction of 20 miles of 115-kilovolt transmission line from Greeley to Loveland, Colo.
Do	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on Big Thompson River, a 1-mile tunnel, 12 concrete siphons, 1 steel siphon.
Do	Switchgear for Granby pumping plant.
Columbia Basin, Wash	Dispatchers board and desk for Grand Coulee left powerhouse.
Do	Main control board and terminal board extension, graphic board, and unmounted switchboard equipment for left powerhouse, Grand Coulee.
Do	Station service auxiliary equipment for Grand Coulee right power plant.
Do	Cable for tie circuits for the Grand Coulee power plant 230-kilovolt switchyards.
Do	Dexing motor-generator sets for Grand Coulee power plant.
Do	Generators for units R4, R5, and R6, Grand Coulee power plant.
Davis Dam, Ariz.-Nev	Construction of 83 miles of 230-kilovolt transmission line from Davis Dam to Parker Dam; steel structures and towers.
Do	Construction of five 22-foot diameter, welded-plate-steel penstocks.
Klamath, Oreg.-Calif	Construction of Adams 60 cubic-feet-per-second concrete pumping plant.
Klamath Lake, Oreg.-Calif	Pumping units and motor control equipment for pumping plants E and F.
Missouri Basin—Frenchman-Cambridge, Nebr	Construction of earthwork and structures for 12.5 miles of Cambridge Canal.
Do	Construction of Medicine Creek Dam, earthfill, approximately 107 feet high, 3,600 feet long.
Missouri Basin—Power transmission lines unit, Nebr	Transformers, reactor, oil circuit breakers, disconnecting switches, fuses, instrument transformers, lightning arresters, for Bridgeport substation.
Do	Transformers, oil circuit breakers, disconnecting switches, fuses, instrument transformers, lightning arresters for Sidney substation.
Shoshone, Wyo	Control and relay board for Garland substation No. 2.

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1947

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Featuring:

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Highlights of the RA Convention

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ARIZONA'S 500 YEARS OF rrigation History
by
Odd S. Halseth

•

Australian ngebusting Plow
by A. C. Hall, Jr.

THE Reclamation ERA

Photo by Norton T. Novitt, Region VII

Tree-Trimming Tots

These youngsters are getting all set for Santa Claus' visit to their home in the "Government Village" at Estes Park, Colo. The one at the extreme right is "looking for reindeer tracks."

Estes Park, where the children reside, is headquarters for the Bureau of Reclamation's Colorado-Big Thompson project, on which the Alva B. Adams 13-mile tunnel was recently dedicated. It is the longest irrigation tunnel in the world, slightly in excess of 13 miles from portal to portal. Its purpose is to divert water from the western to the eastern slope of the Rocky Mountains to supplement the irrigation supply for more than approximately 615,000 acres of inadequately watered lands.

Season's Greetings

To Our Readers

Reclamation ERA

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Ruth F. Sadler, *Editor*

Our Front Cover

Peace on Earth

A light in the window, a star in the East, and a child in the West hears the story of Christmas as Rachel listens to her father, Roy Dement, explain the significance of the Yuletide display which won for him the first prize in the small homes division of the contest sponsored during the 1946 Christmas celebration by Plainview, Tex., businessmen.

This photograph was taken by A. E. McCloud, when in Region V.

Santa Says: *Solve your gift problems this easy way!*

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12 Christmas Gifts In 1

This Christmas gift will be a year-round reminder of your thoughtfulness and will furnish the recipient with a monthly summary of the latest developments in reclamation activities.

The annual rates are $1 for regular subscribers, 50 cents to members of water users' associations, and $1.50 for persons living outside the United States and Canada.

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• HIGHLIGHTS of the NRA Convention •

National figures of both major political parties attending the sixteenth annual convention of the National Reclamation Association at Phoenix, Ariz., October 29–31, demonstrated the nonpartisan character of Reclamation as a national policy, as attested by the support which was given irrigation expansion to conserve water and land resources in order to provide for increased food demands at home and abroad, as well as settlement opportunities for veterans and others in the West.

Senator Hugh Butler of Nebraska, chairman of the Senate Public Lands Committee, at the annual banquet told the convention he favored speedy completion of authorized Reclamation projects and was supporting supplemental appropriations for this fiscal year for such projects as Columbia Basin where irrigated land is needed for veteran settlement.

Representative Ben Jensen of Iowa, chairman of the House Interior Appropriations Subcommittee, who, like Senator Butler, visited many Reclamation projects this fall, gave assurance additional construction funds would be forthcoming to keep work going on Columbia Basin and several other projects.

Wherry Urges Unanimity

Senator Kenneth S. Wherry, of Nebraska, chairman of the Senate Interior Appropriations Subcommittee, called for western unanimity for Reclamation as an indispensable aid in securing congressional appropriations. He likewise called for expediting construction. He cited the great progress made in western Nebraska through Reclamation's North Platte project as an example of what Federal irrigation would do in other sections of Nebraska and the West.

Secretary of the Interior J. A. Krug, in his prepared address, proposed a 7-year Reclamation program to bring 4,000,000 additional acres under irrigation, and double the capacity of Reclamation power installation at an outlay of more than 2 billion dollars.

Secretary of Agriculture Clinton P. Anderson told of the world need for food and of his department's interest in and support of irrigation.

Lt. Gen. R. A. Wheeler, Chief of Engineers, War Department, hailed the coordinated program of the Bureau of Reclamation and Corps of Engineers in the Missouri River Basin as paving the way for even greater cooperation among these agencies.

Assistant Interior Secretary William E. Warne warned of the inroads of soil erosion on the agricultural future of the Nation and urged constructive measures to combat this maiming of the Nation's wealth.

Among the proposals of particular interest in many Western States was the unqualified endorsement by Senator Butler of a pending Senate bill directing the transfer to the Bureau of Reclamation of all irrigation activities now under the Bureau of Indian Affairs.

Other national figures at the convention included United States Senators Hayden and McFarland of Arizona, Watkins of Utah, and Murray of Montana; Representatives Edward H. Jenison of Illinois, Lemke of North Dakota, D'Ewart of Montana, Fernandez of New Mexico, and Murdock of Arizona. Next year's convention will be held at Oklahoma City, Okla.

The following officers were elected: Harry E. Polk of North Dakota, president, succeeding Judge Robert W. Sawyer of Oregon, who was again nominated for the office but declined to serve; Clifford H. Stone, of Colorado, first vice president, J. E. Sturrock of Texas, second vice president; H. M. Ahlquist of Washington, treasurer, and Don McBride of Oklahoma, secretary-manager.

Resolutions adopted by the convention are summarized as follows:

- Urged and recommended that the Congress adequately support a snow survey program to meet the needs of the various water users in the Western States.
- Eliminating Interior Department appropriation act limitations for transfer of work to be performed by the Chief Engineer of the Bureau of Reclamation at Denver.
- Recommending that force account work be permitted on reclamation projects.
- Supporting congressional legislation assuring water user organizations "the right to acquire permanent water rights and control of their distribution facilities."
- That Congress appropriate sufficient funds for revegetation and fire control of watersheds.
- Urging the appropriation by Congress of sufficient funds for the United States Geological Survey.
- Asking for a long-range program by the Federal Government by which Congress can set up funds in adequate amounts to carry through construction work on Reclamation projects at the most efficient and economical pace.
- That uses of water in non-navigable streams be subject by Federal statute to State law.
- Expressing appreciation to members of Congress for their interest in the National Reclamation Association.
- Commending the Department of Agriculture and urging the Bureau of Reclamation to seek cooperation of its agencies and the State colleges.
- Urging enactment of House bill 2873 by Congress which will aid in the promotion of reclamation projects and to relieve water users on existing projects from costs at-

(Continued on page 264)

Letters to the Editor

We Started Something

WASHINGTON, D. C., *August 6, 1947.*

DEAR EDITOR: In the June issue of the RECLAMATION ERA I found on page 128 an article entitled "Who Started It?" having reference to the initiation of the first irrigation works in our country. I read this with a great deal of interest and then took the liberty of asking my good friend, Mr. Odd Halseth, archaeologist of the city of Phoenix, Ariz., and superintendent of the Pueblo Grande Ruins near that city to supply me with some authoritative information relative to irrigated farming practices of our Indian tribes of many hundreds of years ago who lived in the Salt River Valley area of my State.

It seems to me that it might be well to call to the attention of the many readers of the RECLAMATION ERA the fact that efficient and worthwhile irrigated agriculture flourished in Arizona long before the first white man set eyes upon that wonderful country. With kindest regards, I am,

Yours very sincerely,

CARL HAYDEN,
United States Senate.

As a result of Senator Hayden's interest, we are privileged to publish the article on the opposite page written by Archeologist Odd Halseth especially for the RECLAMATION ERA.

The Bureau has always made a slight distinction in definition regarding the "first" irrigation—considering Utah's claim valid as the first large-scale Anglo-Saxon irrigation in this country. However, the study of pre-historic and pre-White Man irrigation methods teaches many lessons of an agricultural as well as archeological nature.—Ed.

Seed . . . . .

ZURICH, MONT., *October 7, 1947.*

Dear Editor: . . . The ERA is better all the time. Success to it.

Yours very truly,

J. F. SHARPLES & SON,
Bliss Triumph Potatoes,
Seed and Table Stock.

The Era Goes to the Fair

PUEBLO, COLO., *August 18, 1947.*

DEAR EDITOR: In regard to your letter of August 15, 1947, replying to our request, in which you offer us past issues of the RECLAMATION ERA, we will be very happy to have a number of copies for distribution from our booth at the Colorado State Fair during the week of August 25. The number of copies will be left to your discretion. I will guarantee that any number that we might have left at the close of the fair will be distributed personally by me in the 12 counties of the Arkansas Valley.

We appreciate very much your generous offer, and I trust the people of the Arkansas Valley will provide quite a number of subscriptions for the ERA in the near future.

Very truly yours,

ROGER ERNST,
Executive Secretary, Water Development Association of South-eastern Colorado.

Do You Belong to a Club?

Are all the members subscribers to the *Reclamation Era*? This is your magazine; you can make it grow. Only 50 cents a year to water users.

Arizona's 1500 YEARS of Irrigation History

White dotted line in this aerial photo shows remains of Hohokam hand-constructed diversion ditch for early irrigation. Square-shaped mound below modern irrigation system (upper right) marks Pueblo Grande ruins which hold many secrets of an ancient civilization.

by Odd S. Halseth

City Archaeologist and Director, Pueblo Grande Museum and Laboratory
Phoenix, Ariz.

WITHOUT AGRICULTURE there would be no civilization as we now know it. Man would still be roaming the earth in quest for food, without a chance to settle down to a sedentary form of society and with little or no energy left over for the so-called civilized pursuits of life.

Civilization, or culture of today, is largely a result of man's liberation from spending all his energy in the search for edible plants—and this liberation was brought about by agriculture, or domesticated crop production.

We therefore speak of the "germ of civilization" as wheat in Egypt and Europe, rice in Asia, and—at a much later date—maize, or corn, in the Western Hemisphere.

Much of the early history of agriculture is a matter of written records, except for the Americas, where no phonetic system of writing was in use prior to Columbus. For this reason archaeology plays an important role in unfolding the pre-Columbian chapters of American history.

After the American Indians had learned to cultivate corn and could settle down to sedentary living, they left an accumulation of material remains which have become a great aid to archaeological investigations.

Culture history and chronology are inherent in human refuse deposits, so archaeology must deal with pots and skulls and other material evidence. But it must also deal with the reason for man's behavior and act as the historical detective branch of anthropology, which includes all the branches of the study of man. Archaeology alone cannot solve all the mysteries of human behavior, and often the most careful field work and laboratory studies only produce new problems without solving old ones.

The history of prehistoric farming in Arizona is based on a number of archaeological facts which are coordinated and interpreted according to prevailing evidence and logic, always subject to new information and revision.

The Pueblo Grande Laboratory

This presentation of desert agriculture and irrigation is based on work and studies conducted at Pueblo Grande, a Municipal Prehistoric Monument, established by the City of Phoenix, Ariz., in 1924, and operated as a museum and laboratory of human research since 1929. The interpretation, of course, is that of the writer's.

Corn found its way into Arizona some time about the beginning of our Christian era, and has been grown continuously since that time in both the northern and southern parts of the State.

In the northern part, and the adjoining areas of New Mexico, Colorado, and Utah, are found a number of ruins of former Indian farming communities, known as Pueblos. This is plateau country and agriculture is based on dry-farming methods. The present Indians devote most of their ceremonial calendar to prayers for rain, much as their ancestors did centuries ago.

Archaeological study of accumulated culture deposits has helped to establish a continuous chronology for these ruins, from the earliest up to the present time and through the presence of timbers with dated tree-rings, accurate dates in our own chronology have been established for many buildings and associated culture material. Where no timber is found to furnish a clue, a relative chronology can be established with fair accuracy through study of such material as trade-ware (pottery, shell, or other objects traded between tribes). This cross-dating is used for ruins found in the desert region, where corn was also grown by irrigation methods.

In the Valley of the Sun (the Salt River Valley) where the city of Phoenix has "arisen from the ashes of the past," like its mythical namesake, and in the nearby Gila Valley, on most of the Pima Indian Reservation, we find evidence of a prehistoric agriculture which was contemporaneous with most of the Pueblo culture on the plateau.

Whereas the Pueblo culture survives to this day, the desert culture seems to have closed its final chapter around 1400 A. D., with what appears to have been a wholesale abandonment of both the Salt River and the Gila Valleys. So far, neither archaeology nor ethnology can prove where the people went or if they have any descendants among any existing Indian tribe.

FROM POST HOLES—and other ruins of dwellings and storage houses—archaeologists find clues to the existence of the Hohokam.

The Pima Indians, who have occupied the same area along the Gila River for about four centuries, speak of the ancients as "Hohokam," a term used to designate the dead, or "those who have vanished." Early investigators report that Pima informers consistently claimed that the ruins of the Hohokam had looked the same "in the memory of all their fathers." However, if one wants to place the Pima in the Hohokam geneology, it can easily be done with a little wishful thinking.

Whereas the Pima Indians occupied the Gila Valley when first encountered by the Spanish explorers, the Valley of the Sun was not resettled until the arrival of American pioneers in 1867. The reason for this may be found to be a study of hydraulic conditions rather than a matter of cultural archaeology.

History Repeats Itself

A study of an irrigation farming culture must include a study of irrigation technology, and, as engineers remind us, all the laws of nature are not operating on the surface, but underground as well, often in a vital, and even fatal, form.

With all the engineering knowledge now available, farmers in this area are at the present time in desperate need of more water, while several conditions indicate that the prehistoric farmers were greatly troubled by too much of the same commodity. A brief survey of recent irrigation history will help to clarify some points in question.

The Valley of the Sun, also known as the Salt River Valley and the Salado Valley, from the name of its river, was first farmed by whites in 1867. The river was then a deep and narrow stream with a permanent flow, far in excess of needs, particularly during the winter months. But with the expansion of farming activities in the valley and, what is far more important, with the destruction of the watershed by cattle, lumber, and mining industries, things began to happen with an alarming speed. The Salado became an erratic stream. Within a few years it left its narrow bed and cut new ones with increasing force of floods from the watershed.

One flood might leave a new channel a mile from the previous one and farmers were kept so busy repairing intake dams that by the time repairs were made, the flood was over and little or no water was left for irrigation of summer crops.

With the passing of the Reclamation Act in 1902, and the subsequent construction of Roosevelt Dam, storage was provided for the floodwaters and the farmers were happy in the belief that their troubles were over. But they figured without the underground activities of Mother Nature, and it wasn't long before another problem reared its head, or at least came to the surface.

This was a rising water table, a condition brought on by the lack of sufficient underground drainage. An estimated one-fifth of the water used for irrigation goes into the ground. Where the natural equilibrium is as sensitive as it seems to be in this valley, it is only a matter of time and irrigation before the table starts rising and the only method of control is drainage by pumping.

By 1918 one-third of productive land was waterlogged in the Salt River Valley. The water table was within a few feet of the surface of some 80,000 acres, and actually covered the surface in some places. During some years the water table rose as much as 5 feet in places measured, but, with the aid of about two million dollars to purchase and install about 200 deep-well pumps, the farmers were saved again.

After the water table had been lowered to a safe depth, pumping continued for irrigation purposes. This, in turn, helped to create a problem which at the present time concerns desert farmers everywhere. The laws of Mother Nature cannot be settled in the legal courts, it seems, and man is slow in realizing that she will not be violated without penalties.

The Hohokam did not suffer any such manmade destruction of the watershed as the rugged Americans did; but, unless Mother Nature inflicted her vagaries only upon the white man, we must assume that the Hohokam farmers also were subject to having their lands water-logged. They spread irrigation water over their lands and sent that fatal one-fifth as an addition to the natural water table for a matter of some 700 years.

The chronology obtained from a large number of undisturbed Hohokam trash mounds reveals an occupation beginning some time before 700 A. D. Many of these trash mounds date from about 1400 A. D. in the top level and go back to the earlier date in the bottom level.

In some trash mounds examined in the Gila valley, the top level *ends* with material from the 700 A. D. period, thus indicating an abandonment of some villages in the Gila Valley at the time the Salado (or Salt River) valley was first settled.

Origins in the Gila Valley

The beginning of the Gila Valley trash mounds starts several centuries earlier, though no accurate date can be given as yet, but it is obvious that irrigation originated in this valley, perhaps by direct flooding from the river and later by canal construction.

The Gila River, unlike the Salado, runs in a bed which is cut through a series of terraces which, in turn, lie several feet below the upper desert level. During high stages of the river, these bottom lands could easily be inundated and covered with rich silt, thus affording an ideal place for flood irrigation and farming on a small scale. It would be an inviting place for any band of Indians looking for a location to plant whatever domesticated seeds they had.

The areas subject to flood irrigation could not have been very extensive, however. As late as a century ago the Gila was described as a comparatively narrow stream, about 75 feet wide in some places, with bottom lands extending for about one-quarter of a mile in both directions. Since both the human and the environmental factors would be closer between Hohokam and Pima history than with our own, it might be well to look at the Hohokam through some of the known Pima experiences.

Before the white intrusion, the Pima Indians lived in about a dozen separate villages, each with its own canal, or ditch.

The total population was about 4,000, divided into some 800 to 900 households, each farming an average of 10 acres. They did most of their work with hand tools made from ironwood, mesquite and cottonwood.

Ditches averaged about 3 miles in length and were dug by the shareholders of each, sometimes within 1 year, depending on the manpower situation. Apache wars, hunting expeditions, saguaro and mescal gatherings and other distractions made some projects last 3 years, or more. The ditches were planned to irrigate the first land about a mile below intakes, which were constructed of "logs, poles, and brush." Except for periodic cleaning, water ran in the ditches "most of the year" and no head gates were used. Water was abundant. Some informants describe the older ditches as about 10 feet wide at the intakes, tapering to from 3 to 5 feet at the terminals. The sides were dug almost straight down with a taper of only about 1 foot, and water usually ran "knee-deep."

With the white man came better tools and implements as well as a demand for farm produce, so after 1860 the Pima Indians expanded their subsistence farming into business production and enjoyed a period of real prosperity.

But not for long. A ruthless civilization was on the march, Mother Nature reacted in her customary manner, and as the water supply gradually diminished, more and more farm land went back to brush and mesquite, and many Indians took up wood cutting and went to work for their neighbors.

After much legal dispute the Coolidge Dam was built and to the detriment of both Pima and archaeology the several floods coming down the Gila, after the destruction of the watershed, washed away much of the bottom land and covered up some areas with many feet of silt. We shall never know how much evidence of early Hohokam occupation has been lost by this change of the valley.

We may safely say, however, that when the time came for the Hohokam to expand their farming to the desert level, their only alternative was to build canals long enough and big enough to carry water to the higher level, which they eventually did.

First "True Irrigation Culture" Along Salt River

This marks the birth of the only "true irrigation culture" in prehistoric North America, and it made it possible for the Hohokam to utilize for the first time the rich lands along the Salado River.

By 700 A. D. a number of settlements were established in the area where Phoenix, Tempe, and Mesa are now located, and during the next 500 years more than 20 villages were occupied, and at least 10 separate canal systems had been constructed.

The construction size of some of these canals was enormous. Some measure over 30 feet from crown to crown and 10 feet in depth. A total of about 125 miles of canal construction has been surveyed in the Salado valley.

FROM PIMA INDIANS—who were using Hohokam irrigation systems when found by the Spaniards—come legends of the ancients.

How much water they carried is, of course, unknown and it may not even be of great importance to the history of what followed. What counts mostly is the amount actually used for irrigation and that fatal one-fifth which goes into the ground to build up the local water table. As yet, no fair estimate can be made of this amount, either. We have to rely mostly on the time element in considering waterlogging of Hohokam lands. Although some village areas are known to have covered from 50 to 75 acres, like that of Pueblo Grande, we cannot use this for a population estimate.

Hohokam dwellings were flimsy structures with no lasting quality. The custom of burning a home where death occurred was, and still is, common among desert tribes and probably was practiced by the Hohokam. If so, one single generation would be responsible for the building of several houses in different parts of the village.

Towards the end of the occupation we find another form of architecture in Hohokam villages and it is here that evidence of waterlogging shows most strongly at Pueblo Grande. A huge mound-like structure, common to all late village sites, was constructed at Pueblo Grande during the last centuries of Hohokam history. The mound itself covers an area of about 300 by 150 feet and stands to a height of more than 20 feet above the desert level.

Superficially the mound resembles the caved-in ruins of a multi-storied Pueblo type of dwelling, which is the main reason for the early archaeological designation of the Hohokam ruins as Pueblos.

Some archaeologists still refer to these mounds as ruins of multi-storied dwellings, although only one such ruin has been found so far in the Hohokam area. This is the "Big House" at Casa Grande National Monument, which is the only one of its kind and unlike the typical Hohokam mounds, although it was also used as a granary.

Excavations of the Pueblo Grande mound show that it was built up by a series of purpose fills and that on the top of each fill a single-storied structure was erected for storage purposes.

On the bottom levels floors are found with storage pits and storage bins, with evidence of much decayed vegetable material. One room on an upper level produced a large number of storage ollas (earthenware jars), many of which were filled with charred corn. So far there is no evidence of any domestic use of the filled areas, so we may reason that each floor level, of which there are eight, represents a granary structure.

Floor plans vary with each level, showing both masonry and wattle wall construction. No large roof timbers, such as those used in Pueblo construction, are in evidence and roofs appear to have been of typical desert materials and style—the forked post with poles and brush covering. The fills consist of materials from gravel, loam and old trashmound deposits and were carried in by the basket load. After the first two fills a masonry wall was built around the mound to retain the dirt on each extended platform level. Rooms were later built against the outside of this retaining wall and another separate wall enclosed the whole unit, forming a compound not unlike the arrangement of the "blockhouse" built for protection against the Indians on the Plains.

(Continued on next page)

FLAX—Newcomer to Klamath

by A. D. Harvey

Klamath Falls, Oreg., Region II

Test planting of flax varieties at Tule Lake Demonstration Farm, Tule Lake, Calif. The farm was established by the University of California, in cooperation with the Bureau of Reclamation and the Tule Lake Growers' Association.

Interest in the growing of flax has been on the upswing in the Klamath Basin of Oregon and California since 1939 when the first field plantings were made for the production of seed.

Cool weather prevalent in the basin favors the growth of flax. The occurrence of frost during the growing season, however, has to some extent discouraged a more rapid development of flax raising as a permanent enterprise.

Plantings made during the latter part of April and the early part of May successfully develop and mature a seed crop in four and a half months so that by early September, although the plants are not quite dry enough to cut, the seed crop is ready for harvest.

Today, the Klamath Experiment Station, located near the Municipal Airport at Klamath Falls, Oreg., continues its research on flax started as far back as 1938.

Varietal plantings to test their reaction and adaptability to local conditions are being made with the view toward obtaining high yielding varieties or strains favoring local conditions.

The Tule Lake Demonstration Farm, located at Tule Lake in the California portion of the basin, has also undertaken the observation of varietal plantings suited to the area comprising lands reclaimed from the bottom of Tule Lake.

Flax does well under irrigation in the better soils of the basin. It is a plant which demands only slightly more water than the small grains for its development but tolerates amounts sufficient for the growth of legumes. This capability makes flax an excellent nurse crop for leguminous plants without entering into competition with the requirements of such crops.

Plantings at the rate of from 40 to 50 pounds of seed to the acre have produced, on good soils, yields of as high as 25 bushels of seed per acre.

Present market prices of slightly above the support price of $6 per bushel result in a gross revenue of over $150 per acre. The cost of raising flax compares closely with that of raising grain. The cost of harvesting, however, sometimes includes the expenditure incurred in windrowing or in topping when the crop is either too weedy or not quite dry enough to combine.

Some of the better known varieties, such as the Bison, the Midland or the Redwing, have been grown in the basin and have produced good yields. Frosthardy varieties, such as the Crystal variety which is now being tested at the Klamath Experiment Station and others which may produce seed high in oil content, will, no doubt, eventually find their way into the field of commercial production.

It is estimated that in 1947 approximately 1,000 acres of basin land were devoted to the production of flax for seed.

Continued interest in the growing of flax, and in the maintenance of a stable market for flax seed, bids well for this crop to become a permanent member of the family of crops composing the pattern of agricultural enterprise of the Klamath Basin in Oregon and California. ●

1500 Years

(Continued from page 253)

Therefore, we have evidence pointing to the use of these structures for both food storage and protection. Farmers always have gone to greater effort in building safe storage for their crops than in making their own dwellings, and no effort is too great for protection against marauding enemies.

But why the fills? Of the many possible answers, the most logical seems to be waterlogging. With a rising water table and the capillarity of desert soil, moisture easily could have found its way to the granary floors during late Hohokam times, and every farmer knows what that means. With no facilities for pumping, the Hohokam probably hoped to escape the moisture by elevating their granary floors and kept on filling until they finally decided to leave the valley.

When they left, there must have been some who could not be taken along, or refused to leave for other reasons. This remnant seems to have built their dwellings on the highest available ground and we find their remains on the last level of the abandoned granary mounds.

Within a little more than two centuries the Hohokam compounds and granaries had been built, filled in and rebuilt several times, and finally abandoned. Even the Casa Grande compound and village were abandoned, probably last of all.

About 1500 years of irrigation history has shown that many irrigation problems are common to the past and the present and that it pays to correct past mistakes before making new ones.

In one way our society differs from that of the Indians. With them, responsibility was to the family and tribe only; ours is to the whole world, as well as to the Nation, the State and the community. ●

(Photographs used with this article were kindly submitted by Mr. Halseth from his personal files.)

Perplexities Unlimited

by Raymond F. Lund,

AGRICULTURAL AGENT, CHICAGO AND NORTH WESTERN RAILROAD

EDITOR'S NOTE: Although a year has passed since Mr. Lund presented this symposium of perplexities to the Wyoming Reclamation Association (at a meeting held November 7, 1946, at Thermopolis, Wyo.) this paper is presented here as a matter of wide—and still current—interest to those concerned with the complex problems of reclamation.

It seems to me that the field of reclamation is fraught with "Perplexities Unlimited."

Let me call attention first to some of the more common problems leading to unlimited perplexities; second, to the necessity of facing the issues; and third, to our responsibility in accepting the challenge.

My first contact with irrigation was about 22 years ago at Billings, Mont., the center of a large irrigation project. Later during the drought years I saw numerous attempts at irrigation in the eastern part of South Dakota in an area where it had little or no application prior to 1933 and 1934. I became actively interested in the Rapid Valley project at the time I assumed the Pennington County extension duties, which work brought me in close touch with Reclamation activities in western South Dakota. Subsequently early in 1940, upon becoming identified with what was then known as the Wheeler-Case program, as project supervisor of the Rapid Valley and Angostura projects, it was my privilege to visit many Reclamation projects in the West, for making observations and studies concerning their desirable features as well as noting their limitations.

A few ditches to water some land for pasture and a number of wooden flumes to carry a little water to a "miner's diggings" were the small beginnings of that great job of conserving and using the most important resource of our Western States—water. Today great projects as well as small are built to conserve the water.

With the passage of the Reclamation Act of 1902, a new era was ushered in. Prior to this time, irrigation enterprises had been undertaken through private initiative, as in those days it was a comparatively simple matter to divert water from streams onto adjacent land. However, as it became necessary to divert and carry water by canal to more distant lands, projects became too costly for a local group to undertake. In many instances, large and costly storage reservoirs became necessary. The Federal Government entered the field to finance the building of projects with a period of years provided for the repayment of construction costs without interest.

People flocked to those early reclamation projects, settling thereon as if through a wave of the magic wand, water would flow and the desert bloom as a rose. Disappointments followed. New problems unknown to earlier irrigation projects arose. In some instances, the water supply was found to be inadequate to meet the needs of the project as previously contemplated. This may be attributed to the fact that complete rainfall and run-off data were lacking at the time early construction was undertaken.

With a limited knowledge of water requirements for the various crops, many farmers had to work out their own methods of application of water to the land. Sometimes more water was used than necessary, which resulted in the leaching and erosion of soil and the seepage of lands. In most instances farmers without knowledge of the area, without information, without guidance, and some without even a background in farming methods set out to develop their respective farms to which water was delivered at the high point.

It required skill and adaptation then, as it does now, to grow crops on arid land under irrigation. Many farmers have had to learn by trial and error. Many found that crops best adapted to soil and climate do not always bring the greatest financial returns. Changing crops to meet changing market demands is costly.

Early Speculation and Tenantry

Individuals invested in land, some for speculation, others to reap the anticipated "great" return that was to be forthcoming from the various crops to be grown. It was natural that tenantry should follow, varying of course to the degree that potential investors became interested in acquiring land on the project which gave promise of outstanding returns on the investment. Now, tenantry is a problem that we find everywhere, which we cannot do much about. We know from past experience however that many tenants let buildings, ditches, and other property deteriorate until conditions become so bad that they seek another farm. Irrigation farming, it seems to me, is a business for landowners.

Taxes are generally high, and become practically impossible to meet during a period of depression such as we experienced in the early 30's. During a period of economic stress the farmer will make an attempt to pay State, county, and local taxes first, to avoid penalties for delinquency, and if he has not enough money, the annual construction payment is deferred. When the going is real tough the land goes for taxes and tenantry increases. Would it not be wise and expedient for local taxing agencies to consider the policy of basing assessment values upon the equity of the water user rather than on full land and water valuation?

The mortgage debt has been a problem. It is unnecessary perhaps to elaborate upon the experiences in the early 20's and even more so in the early 30's when project farmers in general found it extremely difficult to adjust themselves to the rapid decline in farm prices. In this respect their position was no different than that of the dry-land farmer. However, construction costs remained on the same basis during periods of low prices as during the periods of high prices.

Let me refer to one of the early reclamation projects with which I am familiar—the Belle Fourche project in South Dakota. Following the first world war many farmers left that project for reasons which cannot be attributed to reclamation. They were simply broke and disgusted and could not blame anyone but themselves. However, early in the history of that project, we find that there was too much optimism and speculation. Some men went into this section with $100,000 or more, and left with little or nothing. They learned from experience that irrigated land is worth per acre only what it can be made to produce. For instance, back in 1912 a piece of raw gumbo land sold for the price of $100 per acre. It is not surprising that the county later acquired that unit. About one-half the homesteads were taken by nonfarmer elements such as clerks, school teachers, lawyers, and businessmen who expected to make irrigation farming a side line.

Pitfalls of Farming

Insect pests cause occasional heavy losses. Grasshoppers in particular have brought devastation to some projects. Control of the coddling moth has been undertaken at great expense to the apple growers. On a few projects hail storms have inflicted heavy losses. Others have experienced destructive late spring or early fall frosts. Floods have caused damage to crops and canals. Wind erosion has become a factor to be reckoned with on some projects. While these factors are beyond the full control of the farmer, they seriously affect his crop production and his ability to pay his construction costs and other financial obligations. On some projects heavy losses are sustained from noxious weeds.

These and other problems parade in review. Appeals to Congress for extension of time for repayment, for changes in repayment of construction costs, become counterparts among farmers who find themselves in distress, confronted with changing conditions in a changing world. While these are among some of the problems that may be with us always, let us meet them squarely. These may provide the cornerstone, or even the foundation upon which we hope to build for success. What about the design or the pattern by which we proceed to erect the framework of that structure on the foundation so carefully laid? Does it fit? We have used that pattern before, some may say. But times have changed, we are told. Then we must face the facts. Some features of that pattern may have become antiquated.

Results of "Joint Liability"

Joint liability is required in all contracts that have been executed under the provisions of the Adjustment Act. This was intended to provide security for the Government investment and to insure the payment of construction costs. And what was the result? Under joint liability many agencies refused to make loans on project lands even if the individual were a first-class risk. Joint liability theoretically was to provide security for Uncle Sam's investment, but in reality it has created among many farmers a psychological antipayment complex which has been detrimental to the project as well as to the individual. True, that actually no one has been required to assume an obligation other than that undertaken by the individual land owner; however, many farmers have stated that even though they were able to do so, they would not pay, if they could avoid doing so by postponement or moratorium of one kind or another.

In many instances farmers are asking for the establishment of a definite repayment policy. They ask for the elimination of an obsolete requirement, theoretical in its application, that serves to antagonize rather than to encourage the payment of annual construction charges. It seems to me that the leaders of reclamation have a responsibility to assume in helping to devise some sound, practical approach to this feature so as to encourage a wholesome attitude among all irrigators of any project regardless of what their annual charges may be.

The Reclamation Act stipulated that water could not be delivered to more than 160 acres under one ownership. There were good reasons for this provision. Although the basic principle underlying that requirement perhaps has not changed altogether in this day, it seems that some modification would be in order to meet certain conditions which we now observe on some new projects in the process of development.

For example, a study of the Kendrick project in Wyoming indicates that the soil texture, coupled with the average wind velocity for that area, makes it necessary under practical sound farm management to recommend the growing of closely drilled crops and alfalfa rather than the planting of highly specialized row crops which would tend to increase wind erosion hazards. In December 1945 the average wind velocity in that area was 19 miles plus per hour. I have been informed that the average annual wind velocity there has been 13 miles plus per hour. In consideration of the type of agricultural economy that should be recommended for that project, the average operator will be able and should handle more than 160 acres if his operation is to be considered practical and sound from the economic point of view.

I have talked with farmers on some projects who said that they were handicapped because their respective farms were too small to be operated economically. At the time of the passage of the original Reclamation Act, farmers possessed relatively few and simple tools. Motor power as generally accepted today was then unknown. Now with modern machinery of all kinds and descriptions which the farmer has acquired or seeks at the earliest opportunity, his operating cost becomes higher, but he is capable of handling more land and often needs a larger unit if he is to carry forward a successful economical operation of his farm. The farmers of today are not going back to the horse and buggy days of yesterday. While experience has shown that in some sections 40 acres may be ample for a highly specialized operation, in other areas under different conditions, 80 acres, 100 acres, and even 160 acres of irrigable land may not be enough for one unit under one ownership. Let us face the issue as we keep constantly alert concerning the developments of new methods, new operations, new types of equipment with which a farm may become equipped in a progressive, modern changing world. We must be ready to accept change in our pattern and modification of our regulations if we are to meet these changing conditions.

Government a "Liberal Partner"

The original Reclamation Act provided for the payment of construction costs in ten annual installments. Rising costs of construction made it necessary to extend the time of payment. This was authorized by the act of August 13, 1914. The passage of special relief acts was followed by the Fact Finders Act of December 5, 1924. This was then repealed by the passage of the Adjustment Act of May 15, 1926, which authorized the execution of repayment contracts extending over a period not to exceed 40 years. Thus we see that the Government has been a very liberal partner in this irrigation business. Whereas the debt was first to be paid in 10 years, it was later changed to 20 years, then to 40 years. The Reclamation Act of 1939 as amended provides for a repayment period of 40 years with an additional 10 years given to development. Under that act the authority to adjust contracts to extend the repayment period beyond 40 years was left to Congress. As of the present time it appears that about 40 percent of the districts having repayment contracts are requesting amendatory contracts. This neither implies nor means that all of the operators on those districts are in financial difficulty nor in arrears on their payments. Enough operators are apparently in distress, however, on those projects to prompt these districts to request either an adjustment or an amendatory contract.

Facing the Facts

We recognize reclamation's accomplishments—the conservation of water and land resources; the creation of 50,000 or more irrigated farms within Federal projects and the providing of a supplemental water supply for 35,000 or more farms under various acts covering non-project land; the stabilizing of agricultural conditions on many irrigated farms; the providing of a market for midwestern products, both agricultural and industrial; and the increasing of the valuation of land and property.

Forty years of experience has taught that the construction of project works does not complete the work of the project.

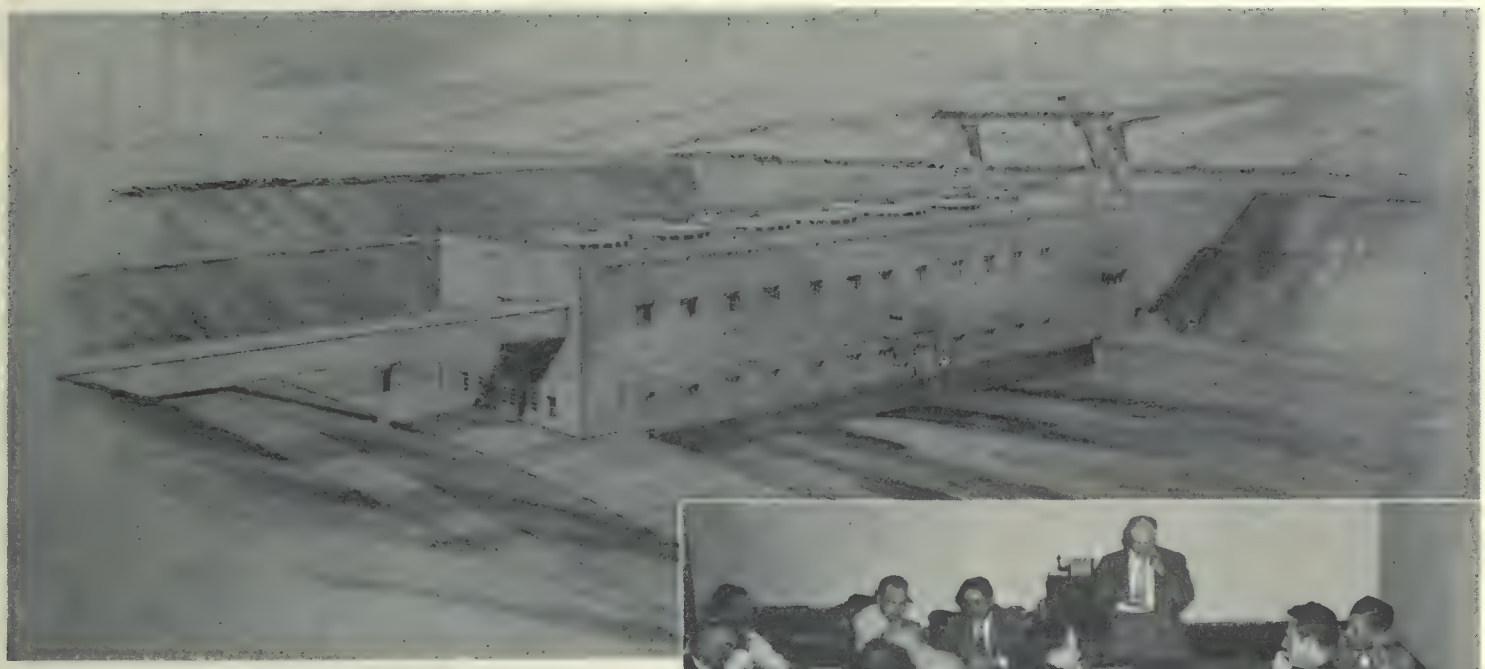
In 1926, the irrigable areas on many of the projects were classified as productive or marginal and nonproductive lands. Land classification was sometimes made by those not appreciating the full importance of the work to be done. Land classification is still being carried forward on some projects. Years of cultivation or tillage of the soil makes for changes in soil characteristics to the end that certain lands that might be classified as nonproductive this year will be found in another category 5 or 10 years hence. On the other hand, some lands that are today considered good production land may be unfit for tillage and the production of crops a few years later. Drainage may then enter the picture to become a costly major undertaking—an additional burden for the project to bear.

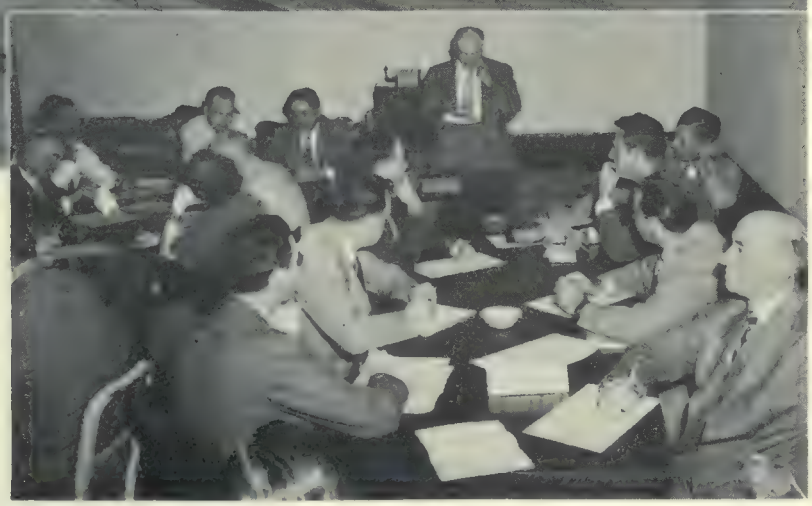
The Federal Bureau of Reclamation has never lost a dam. Its engineering has been superb. It is not from the standpoint of engineering that I view this subject, but from the social and economic aspect. After many years of experience some projects are now operating on a sound financial basis, while others are struggling with a financial overhead that threatens to tear down the very structure upon which the project has been built.

The Reclamation Act of 1902 was perhaps the best that could be devised at that time. It has amendments, perhaps others are needed in order to provide the flexibility desired to meet the various conditions on existing projects as well as those in the making.

It seems to me that the time has come for us to accept the challenge of meeting the problems that stalk many of our reclamation projects. It is only by recognizing

(Continued on Page 260)





The Drama of a Big Bid Opening

By William T. Easterday, *Engineer*,

Branch of Design and Construction
Region II, Sacramento, Calif.

Tension at its highest *as A. G. Boden, Bureau Engineer, Central Valley Project, announces successful bidder for Tracy Pumping Plant. Above is architect's drawing of structure.*

Everybody has seen the great dams, canals and public buildings which represent an expenditure of Federal money in local construction to increase the Nation's wealth. Almost everybody has joined the "curbstone engineers" to watch some of these structures under construction. But to most people, the process by which the big job gets started remains forever mysterious, and all the dramatic events which lead up to construction are passed off with the comment, "Oh, the Government built that!"

Actually, the Government itself seldom constructs, almost never in peace-time. The Government agency designs the structure, buys the materials to be used, and supervises the actual building to make sure that the designs are faithfully executed. But in almost all cases the construction itself is carried forward by private contracting firms, whose own engineers and skilled laborers are equally responsible to the Government and its people for doing a good job.

Since public works very often are public for the very reason that they're too big and costly for private undertaking, these public projects are a large item in the contractor's repertory and competition is keen for Government contracts. Here are the steps whereby a contractor gets signed up for a Government job:

1. The Government draws up specifications, outlining the engineering job in great detail. These specifications are weighty volumes, sometimes running to hundreds of pages. They are distributed to interested contractors without charge for use in preparing bids, and are sold to others requesting them for information purposes at a price usually under $5 This price is less than cost, and in conformance with general contracting practices is charged primarily to keep down the demand and cost which would be involved if wide free distribution were made.

2. The private firm's technical experts study the specifications very carefully from all standpoints and finally arrive at an estimate as to the lowest amount for which it can execute the designs and still make a reasonable profit. A young firm, seeking to become established, sometimes cuts its profit down to almost nothing in order to get the contract and show what it can do.

3. The Government announces a date and place for opening of bids. At a certain hour, usually 10 a. m., all bids must have been submitted in sealed envelopes and the opening proceeds. Often the bids are received at the very last minute, since the firms' representatives gather together before the opening and try to find out what the others are bidding, scaling their own bids down to a minimum just before the deadline.

4. At the precise hour announced, the bids are opened and read aloud by a Government official. Representatives of the construction trade press are on hand, because the name of the low bidder is big news to them. Usually, the contract goes to the lowest bidder, but the Government may find the low bid unacceptable because of some stipulation in the bid or because of the firm's record. Award of the contract is not announced until the Government has studied the bids carefully, usually not until a month after the opening.

Here is the picture of a recent big bid opening for a giant structure in Alameda County—the Tracy pumping plant of the Central Valley project. Region II, which is building the Central Valley project, conducted this opening in its office at Antioch. •

Hybrid Sweet-Corn-Seed Center of

by Merle L. Tillery
Region 1, Boise, Idaho

SIXTY PERCENT OF THE NATION'S SWEET-CORN SEED SUPPLY IN 1947 . . . .

EIGHTY PERCENT OF THE ENTIRE COUNTRY'S REQUIREMENTS FOR HYBRID SWEET-CORN SEED . . . .

These are the results of ideal growing conditions and fertile desert soil irrigated through dependable Bureau of Reclamation facilities on the Boise and Owyhee projects in southwestern Idaho and eastern Oregon.

Aerial view showing hybrid sweet corn seed sou

This year's crop was produced on 6,200 acres planted to sweet corn seed, 5,000 acres of which produced the hybrid variety.

These two Reclamation areas are also excellent for the production of open pollinated sweet corn seed. This is the type of sweet corn used by everyone before the introduction of hybrids. Approximately 30 percent of the open pollinated sweet corn seed used in the United States is produced here, where 1,200 acres is devoted to its production.

The story of hybrid sweet corn seed production is a most intriguing one. At present there are about a hundred varieties. Private seed companies and State and Federal experiment stations are continually working to improve these varieties and to develop new ones.

Golden Cross Bantam a Favorite

Golden Cross Bantam was one of the first varieties to be developed. It is this type that is grown in huge quantities in the Boise and Owyhee areas. It is a yellow corn used for home and commercial gardens, as well as by the canning and quick-freeze industries, and is by far the most popular hybrid, outselling all other varieties.

The principal processes necessary to produce Golden Cross Bantam are interesting. Golden Cross Bantam is the product of two inbred lines of corn. Inbred lines are produced by transferring the pollen, by hand, from the tassel of a corn plant to the silk of an ear of corn on that same plant. Corn is normally produced by cross pollinization, that is, pollen from one or more plants, disseminated by wind, may fall on the silk of an ear of corn to fertilize the kernels on that ear.

The seed companies maintain two inbred lines for each hybrid corn produced for commercial planting. This year (1947) the inbred lines were grown in isolated plots and were pollinated by hand. This consisted of taking the pollen from a corn plant and transferring it to the silk of an ear of corn on that same plant and then covering with a paper bag to prevent other pollen from falling on the silk.

In 1948 the resultant inbred, or hand-pollinated, corn seed will be grown in increased plots under isolated conditions. The following year the two inbred lines required to produce Golden Cross Bantam sweet corn seed will be grown under contract by farmers on the Federal Reclamation projects. Then, in 1950, this hybrid Golden Cross Bantam sweet corn seed will be planted in home gardens, commercial gardens, and grown under contract for the canning and quick-freeze industries. Corn produced at this stage cannot be used again for seed. It will not reproduce true to type. New seed must be purchased for each crop of hybrid corn.

Farmers who produce Golden Cross Bantam sweet corn seed on the Owyhee and Boise projects assume certain responsibilities and follow prescribed practices specified by the contracting seed company. The most important of these are:

- the land selected must be isolated from other corn fields,
- the land must have a high level of available plant food,
- four rows of female (seed ear producing plants) must be planted to one row of male (pollen producing) plants,
- the female rows must be detasseled as soon as tassels appear (this requires going over the field every day for 14 days),
- the farmers must give careful attention to irrigation, particularly at the critical water requirement period (which is during and immediately following the development of the tassel),
- the ear on male plants must be picked and disposed of before harvest (these ears are not Golden Cross Bantam),
- the Golden Cross Bantam must be harvested before frost (because frosted seed is low in germination).

Photo Courtesy Crookham Seed Co., Caldwell, Idaho.

a, Idaho (Boise project). Rows of male corn are denoted by white lines, while female corn is denoted by darker lines.

About 50 percent of hybrid sweet corn seed is harvested with mechanical pickers, while the remainder is shucked by hand.

In this area seed corn at harvest has a moisture content of about 35 percent. To dry the corn in cribs would require too much time, so large artificial drying plants have been provided at Caldwell and Nampa, Idaho, and Ontario, Oreg., to dry the sweet corn seed as soon after harvest as possible. This artificial drying process reduces the moisture content to about 12 percent. As the corn is taken from the dryers it is run through a sheller and sacked for storage to await further processing. Each grower's lot is tagged for identification until final weights are determined and germination tests made.

From storage the corn seed is taken to the cleaning plant where it is run over cleaning machines to remove chaff, husks, pieces of cob, and cracked kernels. Then it goes to the hand-grading room. Here girls and women remove by hand all cracked, dwarfed, undersized, or misshapen kernels. The seed is then sacked and labeled for shipment.

Yields of hybrid sweet corn seed average about 2,000 pounds of marketable seed per acre. However, Mr. C. J. Shellenberger of Melba, Idaho, considered to be one of the best growers in the area, has a 3-year average per-acre yield of 4,300 pounds of marketable seed on a 10-acre contract.

Contract Prices for Hybrid Seed

Contract prices for producing hybrid sweet corn seed vary from 8 to 19½ cents per pound, depending upon the variety produced. These prices are reduced 1½ cents per pound if the seed company does the detasseling. Experienced growers usually detassel their own corn with family or community labor.

The 1947 contract price for Golden Cross Bantam is 9 cents per pound if the farmer does the detasseling, and 7½ cents per pound if the seed company does the detasseling. This gives the average grower a gross per-acre return of $150 to $180, depending on whether he does the detasseling. Mr. Shellenberger with his record yield of 4,300 pounds per acre at 9 cents per pound (he does his own detasseling) has a gross per-acre return of $387.

The acreage devoted to sweet corn seed production grew tremendously on the two developments during the war because of the demand for the production of more food. The acreage rose from 2,500 in 1940 to a peak of 8,000 in 1944.

A large part of the increased production of vegetable and garden seed in the United States during World War II was earmarked and stock-piled for foreign countries.

This was not true in the case of sweet corn seed. Most of this seed was used in home gardens and commercial farms for the canning and quickfreeze industries. A small amount was shipped to Southern Russia. The Army and Navy used sizable quantities of Golden Cross Bantam sweet corn for green corn production in tropical and semitropical areas. It was found that this hybrid sweet corn variety was one of the few vegetables that could be produced under tropical conditions. Three and four crops of Golden Cross Bantam sweet corn were produced each year in some areas.

Experimental work was started on the Golden Cross Bantam in 1922 by Glenn M. Smith, Agronomist of the Bureau of Plant Industry, stationed at Purdue University, Lafayette, Ind. Selection and improvement work continued until 1931 when the first seed was released for trials under field conditions. There has been a great improvement in Golden Cross Bantam since this initial release due to Mr. Smith's efforts and those of the seed trade, and other research scientists in the hybrid sweet corn field.

Other research scientists prominent in the development and improvement of hybrid sweet corn seed are Dr. W. A. Huelsen, University of Illinois, Urbana, Ill., Dr. E. S. Haber, Iowa State College, Ames, Iowa; and Dr. W. R. Singleton, Connecticut Agricultural Experiment Station. In addition to developing and improving hybrid sweet corn varieties, these research scientists also supply the seed companies and growers with information on methods, technique, and "know-how," so necessary in the production of this type of seed. ●

Perplexities Unlimited

(*Continued from Page 256*)

the realities of the situation and then by proceeding to do something about them that we will regain the confidence of those among us who question the feasibility of increasing or enlarging reclamation projects by the Federal Government. Too often we have been guilty of promoting or accepting some enterprises from an idealistic viewpoint, unmindful of the realism to follow. With our feet firmly implanted in the soil, with a grim determination to go forward with plans that recognize the realities of the problem approached, we can then perhaps eliminate the necessity and the practice of recurrent appeals to Congress for moratoriums, for deferment, for write-offs, for adjustments in the construction cost, or for other palliates which but stave off the day of reckoning.

Last Year's Resolves

What are some of the phases of the unfinished task which deserve our considered judgment? Here is the gist of some of the resolutions adopted at the 15th annual convention of the National Reclamation Association in 1946, showing what is needed.

- The release of impounded funds.
- Additional legislation to protect the beneficial consumptive use of water in the west.
- Coordination of activities of Federal map-making agencies to complete all the essential topographic mapping of the United States.
- Amendment of the Reclamation Project Act of 1939 so as to recognize the district as to the amount paid for construction costs, the rights of the district in the water rights it has been using, the right to renew contracts, and the need for termination of control when construction costs are fully paid.
- Further study of the fixed acreage limitation provision now required by the Act of 1902, to be given by special committee.
- Compliance with State laws in the development of projects on the part of any Federal agency dealing with water.
- Utilization of power revenues, without discrimination as to types of operating organizations whether such projects are operated by the United States, by irrigation districts, or by water users' associations.
- Modified contracts with respect to existing provisions concerning the revenues derived from the sale of land on some projects.
- The need of a small projects division in the Bureau with a simplified procedure to handle the small projects seeking equal opportunities with large ones in participating in the Federal Reclamation program.
- The enactment of a Federal stream abatement pollution law to protect and preserve States' interests.
- Legislation to clarify and elaborate the factors to be used in the determination of economic justification of reclamation projects in view of the Department of Interior Solicitor's opinion respecting the application of power revenues on Reclamation projects.
- Additional research in the field of irrigation and drainage.
- Coordinating the efforts of all Federal agencies concerned with the development of our natural resources by the legislative and executive branches of the Government.

These are among the 24 resolutions adopted at Omaha last year.

By directing the energies of research to the entire field of reclamation with all of its ramifications, we shall be taking some of the necessary steps toward answering many of the pertinent questions raised. However, studies alone will not do the job. Hearings, investigations, and reports are not enough. We need action now!

If a mistake has been made, let us not continue that mistake. Rather, let us proceed to rectify an error, whether it was made yesterday or has the slightest indication of reappearing tomorrow. By first recognizing our mistakes, then facing the issue, we shall be able to accept the challenge for completing the task remaining before us.

Perplexities Unlimited? Yes! But these provide us with the challenge that should spur us onward toward the achievement of our ultimate objectives, as we proceed to do the things "that couldn't be done."

We know from past experience that agricultural development has preceded industrial development. Speaking for the carriers in this program of carrying reclamation forward, our interest is so obvious as to seem not even necessary to require a statement.

There can be no separation of the interest of this western country from the interest of companies which provide transportation facilities. We advance or we retrogress in the same direction and at the same ratio as the territory we serve. We dedicate ourselves to the purpose of bringing an adequate, sound agriculture in this country. Maintenance and support of the present reclamation policy is the means of achieving that goal in the arid regions. We have supported and will continue to support Reclamation Associations. What we have done in the past we will continue to do in the future. We hope to do our part to help spread community prosperity just as far as it can be spread by the practical use of water that falls in the entire water shed. ●

Water for the Asking

From Nampa, Idaho, comes the story of a Kansas farmer, a Nampa businessman, and a Nampa farmer.

While the farmer from Kansas was visiting the businessman, in walked the Nampa farmer, who ran a farm owned by the businessman.

"I need some additional water for my beet field," he told the owner. The latter called the irrigation district office, reported what was needed, nodded, said "Okay" as he was told the price and that delivery of the water would be made as requested, and hung up.

The Kansan listened with rapt interest. "Just what did you do?" he asked.

"Oh, I just ordered three rains 10 days apart," was the answer.

"Gawd," responded the amazed Kansan. "Can you do that out here?"

New Maps Available

The following recent project maps have been prepared by the Washington, D. C., office of the Bureau of Reclamation:

Shoshone project, Wyo.-Mont., map No. 47–57, four colors, red, green, blue, and black, size approximately 10½ by 16″, price 15 cents.

Same map numbered 47–54, three colors, blue, green, and black. Size approximately 10½ by 17″, price 15 cents.

Minidoka project, Idaho, map No. 47–55, three colors, blue, red and black, size approximately 8½ by 11″, price 15 cents.

Same map numbered 47–55A, approximate size 19½ by 26″, price 25 cents.

1946 Index and Bound Volumes of Era Available

A limited supply of bound volumes of the May through December 1946 issues of the Reclamation Era are now available at $2 a volume. Separate copies of the Index to these numbers are free upon request.

Make check or money order payable to Treasurer of the United States. Postage stamps are not accepted. Address order to the Commissioner, Bureau of Reclamation, Washington 25, D. C.

Do You Plan To Move?

If so, please notify the *Reclamation Era* so that you may continue to receive your copy regularly.

OPENING DAY at Model Farm

"Unusual weather" fails to dampen enthusiasm for the first field day at Columbia Basin Project's Development Farm

by Gene Nicolai, *Coulee Dam, Wash., Reg. I*

Photos by Harold Foss, Region I

Seventeen thousand farms like this one will eventually dot the Columbia Basin Project landscape.

Farm houses of this type will constitute the nucleus of the future communities which will cover a million acres.

It was a cold, drizzly October day at the Bureau of Reclamation's Development Farm on the Columbia Basin project of eastern Washington.

Kenneth Hampton, wounded veteran of World War II and operator of the 80-acre demonstration plot, frowned at the dismal sky. Then he looked thoughtfully at the smoothly graveled driveways, the maturing corn and potatoes, the sprouting alfalfa and clover, the newly painted machine shed converted from a war-surplus airplane hangar.

"Doesn't look like much of a crowd," he told his young wife.

Out near the machinery shed, John L. Toevs, land-development director of the project, which is headed by project development supervisor W. W. Johnston, pulled out his watch. It was 1:05, five minutes past the time set for beginning the first field day on the farm, two miles east of Moses Lake.

A flat-bed truck, carrying a man, wife, and baby turned down the side road, rattled by the almost-four-room farm home and stopped near Toevs.

"We've come to look over the farm."

"Glad to see you," Toevs answered. "Just park over there. The meeting will be in the machinery shed at two."

And then, streaming from Moses Lake and from roads channeling from other parts of the million-acre expanse, came a steady flow of cars and trucks. Toevs lighted his pipe and grinned. Hampton hurried out to direct traffic while his wife hustled their 3-year old daughter into a new dress.

They kept coming—school buses, new sedans, old coupes, even a motor scooter. And by 1:30 o'clock, the crowd, swelled to more than 400, began a tour of the farm dwelling designed at Washington State College. Others ignored the chilling rain and wandered through the fields, exchanging views about the 10-foot hybrid feeder corn, examining the Netted Gems, asking questions about the milking parlor, the machinery, and the well which will serve the farm irrigation system until water from the project's main network reaches the Basin.

By 2 o'clock they had filled all seats in the machinery shed and were perched on cement sacks, empty boxes, potato diggers, and oil drums.

The first field day at the first development farm on the Columbia Basin project was a success.

Toevs opened the meeting with the greeting: "Well, folks, we're glad to see you here."

He was speaking to prospective settlers waiting for water to reach the parched lands in the basin, to agricultural agents of railroads, Chambers of Commerce, the Grange, Washington State College Extension Service representatives, the Bureau of Plant Industry, the Columbia Basin Commission. He made a plea for weed control to his listeners, many of whom operate farms served by private irrigation in the Basin. He explained the cooperation of the State College and the Prosser (Wash.) Agricultural Experiment Station in the development farm program.

Congressman Hal Holmes from Washington's fourth district was principal speaker. He commended the development farm plan as a guide for future settlers.

"Farms like this, using poorer type soils as well as the better soils, show the transformation of sagebrush to crops," Congressman Holmes said. "Here they will practice rotation of crops, carry on scientific research, and study planting of various crops to help those who will farm in the Basin. Here a vision has been transformed into cold reality.

"Irrigated farms like this show what happens when life, in the form of irrigation water, reaches this arid region. Your presence here proves you are people of vision. Men without vision are lost; men with vision can do wonders."

Ned Thomas, president of the Moses Lake Chamber of Commerce, which long had planned the initial field day, introduced

(Continued on Page 266)

Veteran Assistance at Minidoka

In the aptly named "Magic Valley" of southeastern Idaho new settlers will have help in building self-supporting farms

by Ernest J. Palmer

Hunt, Idaho, Region I

Veteran Glenn A. Parsons, (left) receiving advice from Harold L. Harris, Work Unit Conservationist of the Soil Conservation Service, Jerome, Idaho.

←*Photo by Phil Merritt, Region I*

The mere drawing of a name from a bowl is but a small beginning in the building of a fertile irrigated farm on a patch of public land now barren desert. The actual transformation of sagebrush land into a productive unit is a major job, one that taxes the best of the men who undertake it.

To many of the veterans who won a piece of the 3,226 acres of public land opened to homestead entry on the Gooding Division of the Minidoka project, in Idaho, where the Japanese evacuee camp was situated, it is a particularly new adventure One said:

"Why, I've farmed all my life but I don't even know how to walk up to an irrigation shovel. Can I get help from someone who can show me how to irrigate?" "Where do we get our water?" "What's a lateral?" "What's a sub-lateral?" "What's a corrugation?" "How much water do you run down the ditch?" "Can I get help in laying out my irrigation ditches?" "How do I get the sagebrush off the land?" "Are schools available?" "How can I get water for my household use?" "Can I get electricity?"

While all of the men have had three years of full-time farming experience after reaching the age of 15, as required in qualifying for the drawing, many never irrigated before, and about half came from outside the State of Idaho and thus are unfamiliar with local conditions. That the winners would need advice and other assistance in bringing their land to the productive stage was evident long before the first name was drawn from the bowl.

Although some old-timers may say that the new settlers should not be "wet nursed," that they should have to dig for themselves, the more thinking person will agree that the new farmers will have plenty of trials and tribulations despite all the help they will get. They'll need courage, ambition, and must put in long hours and plenty of hard work to make a success in their undertaking.

Then, too, times have changed. The new settlers must develop their farm units quickly and efficiently because of high living costs and lack of capital. Otherwise, they'll surely lose out.

In January 1947 the Bureau of Reclamation stepped out and squarely faced the problem of how best to provide settler assistance on the Minidoka project. Through its land use specialist it conferred with local representatives of other agencies who had a service to offer rural folks. It was readily agreed by all that the best way to provide the aid was to form a committee, an Inter-Agency Committee as it were, consisting of representatives of all the organizations involved, which would plan, coordinate, and carry forward the most helpful program possible for the settlers. The committee should be ready for action when the first settler arrived.

The first meeting of the new group was held on January 15, 1947, and meetings have been held regularly ever since. The land use specialist was elected Agency committee coordinator and the county extension agent was elected secretary. Represented on the committee are: University of Idaho extension division, Idaho State Board of Education, Idaho Employment Service, Farm Home Administration, Production and Marketing Administration, Soil Conservation Service, and Bureau of Reclamation.

The settlers who have taken up residence on the project are appreciative of the help they are receiving through this group. Under the plan a definite delineation of responsibilities has been outlined for each agency. The activity of each is outlined below:

Bureau of Reclamation

The Bureau laid out farm units according to the topography of the land and the

acreage required to support an average family at a suitable standard of living.

Under Public Law 478, Seventy-ninth Congress, second session, buildings and certain personal property used at the War Relocation Camp, such as bathtubs, blankets, rubber boots, shovels, sewing machines, chairs, and kitchen utensils, were transferred to the Bureau of Reclamation. A great deal of this property has been allocated to the veteran homesteaders and many of them are actually removing these materials to their farm units.

Electricity for the farms was made available through the efforts of the land-use specialist and the project superintendent, working with power company officials. As a result, homesteaders can obtain electric power within a few days after they request the service.

Veterans need schools for their children, too. The Inter-Agency Committee can take credit for having the Hunt unit taken into the Eden School District, and having the district provide busses to transport the youngsters to and from classrooms. The Bureau assisted the district by giving it a school bus and two barrack-type buildings.

Where could veterans live while building their homes? That question was quickly answered by the Bureau by providing them with temporary housing in two blocks in the former Japanese evacuee camp. A laundry building, with showers, toilets, and wash basins, is available nearby. The settlers appreciate these accommodations. As one said, "This certainly beats living in a tent, such as my dad had to do when he was homesteading."

The Bureau extends settlers a warm welcome through the land use specialist. The "welcome" includes giving them information on how the unit might best be irrigated and on the assistance that is obtainable and showing them the buildings and personal property and temporary housing that is available. The veteran also gets information such as how to file his homestead entry or contact building movers.

One of the main jobs that the land-use specialist is doing—and the one that is probably appreciated most by the settlers—is to assist them in laying out farm fields, irrigation systems, and locating farmsteads and to provide accurate information on the leveling that is necessary. This work is done out in the field with the specialist operating the level and the farmer the rod.

University of Idaho Extension Division

Briefs containing reliable information on the types and kinds of farm equipment necessary to grow various crops are being provided by Virgil Cross, Jerome County Extension Agent. Another brief, called "Recommended Seeding and Crop Table, Hunt project," is also available. It gives the planting time, rate of seeding, best source of seed, and varieties of seeds adaptable in the Hunt area. The county agent will also provide briefs on farmstead location and on the selection of livestock breeding stock and such others as the veterans may need. In addition to giving individual assistance, the county agent holds educational meetings with the Hunt settlers during the winter months, when the extension specialist can assist him.

Agent Cross is not only able to assist the settlers with the above educational program, but he also knows the best fishing streams in Idaho. Several of the settlers seem to be very interested in this phase of the settler assistance program.

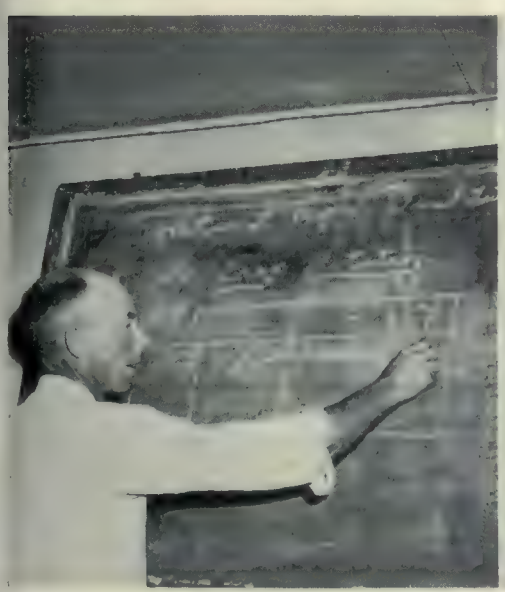
Idaho State Board of Education

Under Public Law 346, Seventy-eighth Congress, second session (commonly known as the GI Bill of Rights), qualified veterans are entitled to take institutional on-the-farm training. The new farmers are eligible for a 1-year training program, plus one additional month of training for each month spent in the armed forces, but not to exceed four calendar years. During this training period, the Veterans' Administration will make subsistence payments to veterans enrolled in the agricultural courses.

The State department of vocational education, through its agricultural education branch, will establish this training program for the veterans at Hunt. Clare Hunt, assistant in charge of veteran training and on-the-farm training, and Henry Schodde, district supervisor, department of vocational education, have prepared the program. The class will be held in one of the warehouses at the Hunt camp with Bart Gardner as agricultural instructor. Courses will be offered in crop and livestock production, marketing, farm management, and irrigation practices, as well as any other training which will be of specific value to the ex-soldier settlers on this project. For practical illustration as part of the course in agricultural engineering, Gardner will work with the settlers in remodeling their barracks into farm homes, assist them in preparing equipment to move their buildings, etc. The course will be part individual instruction and part classroom work.

Production and Marketing Administration

Major benefits are to be gained under the Production and Marketing Administration program. Practice D–15, for instance, will allow the settler $6 per acre for preparation of land for irrigation. Through L. E. Pool, chairman of the Jerome County Agricultural Conservation Association Committee, the closing date for signing plan sheets was extended from



Photos by Phil Merritt, Region I

The three "R's" (especially Rotation) will play an important role in the program as shown by Henry Schodde at the blackboard. At center, County Supervisor Verl Unander of FHA discusses with Veteran William R. Niedrick the possibility of using the water tower for domestic supply, and at right, the Bureau's land specialist helps veteran Carl Blanford survey for a main ditch location.

Photo by Phil Merritt, Region I

Hunt Inter-Agency Committee swings into action mapping plans which will help shape the destiny of lucky veteran homesteaders on the Minidoka Project, Gooding Division.

May 1, 1947, to September 1, 1947, for the special benefit of the Hunt homesteaders. The Inter-Agency Committee has mailed briefs to the new settlers giving them information on how to take advantage of the program and listing the practices that would benefit them most.

Farm Home Administration

This agency, represented at Hunt by County Supervisor Verl Unander, will, as far as congressional appropriations allow, make production and subsistence loans to purchase livestock, farm equipment, seed, feed, and other farm supplies and to pay for necessary hired labor, erect necessary minor buildings or make minor repairs. The latter may not exceed more than $100 for a 10-month period.

Loans will also be made by the FHA to purchase essential home equipment, to meet subsistence and medical care of the family, and to individuals or groups to buy sires, equipment, etc.

The agency may also extend credit assistance and technical advice and service for the development of domestic water. It is making a survey of the domestic water requirements of the Hunt settlers. If the existing large wells for the Japanese camp cannot be used to provide water to the 43 homesteaders, it is hoped the FHA will recommend and assist the settler in developing individual wells.

Soil Conservation Service

The Soil Conservation Service will aid the settler in developing individual or group conservation plans, make recommendations on proper land use according to capability classes and assist with other technical surveys. Harold L. Harris, work unit conservationist, represents the SCS on the Inter-Agency Committee.

Idaho Employment Service

Assistance to the veteran in finding outside work during slack periods on the farm and in obtaining hired help during busy seasons will be offered by this agency. Its office is in Jerome and Ronald S. Cutler in charge, will act as veteran information officer. The organization is also the claims-taking agency for the servicemen's readjustment allowance.

In summarizing the settler assistance program on the Minidoka project, it can be said that each and every veteran will find friendly assistance available from every member of the Inter-Agency Committee, which is determined to help the veterans to the fullest extent of the authority of its members. In the last analysis, however, it will be up to each settler to make his own success. Under our democracy, that is as it should be. ●

* Seated left to right: Clare Hunt, assistant supervisor, agricultural education; Henry Schoddc, district agriculture education supervisor; Ronald S. Cutler, manager, Jerome County Employment Service; Verl Unander, county FHA supervisor; O. V. Chenoweth who will replace the present land use specialist; L. E. Pool, Jerome County chairman of PMA; Harold L. Harris, work unit conservationist (SCS); Ernest J. Palmer, present Minidoka land use specialist, and W. Dean Boyle, regional land use specialist.

Correction: Our Front Cover for last month carried the startling news that the Klamath project was located in Washington-Oregon. There is no change—it is still in California-Oregon. The photograph was taken by J. E. Fluharty of Region II.

NRA Convention

(Continued from page 250)

tributable to purposes other than irrigation or municipal water supply.

- Permitting the contracting for surplus waters for irrigation purposes.
- Asking the Bureau of Reclamation to establish a Small Projects Division.
- Proposing that the States own title to all lands beneath the navigable water within their boundaries, which, as to coastal States, includes the marginal shelf, subject to regulatory powers of the Federal Government.
- Opposition to creation of any regional authority.
- Opposing continuation of the Southwestern Power Administration (in Arkansas).
- Urging Congress to follow an annual program of appropriations which will complete currently authorized flood control projects.
- Memorializing Congress to enact Senate bill 912 to remove land limitations from the San Luis Valley project in Colorado, Valley Gravity Canal project in Texas, and the Central Valley project in California.
- Naming of a committee by the association president to draft a Federal law extending the period for repayment of water users' obligations.
- Urged and recommended that no income-tax liability based on power revenues be imposed on water users; and that all net revenues derived from power facilities included in the construction cost of a project be applied to the aid of the irrigation system, such application to be made in manner fair and appropriate to project division involved; it was further urged that an equitable allocation of net revenue from power facilities not subject to repayment by water users shall forever be applied as an aid to the irrigation system.
- That Congress and the Bureau of Reclamation should strictly adhere to the principle of providing adequate, economical supply of supplemental water for existing projects.
- Expressing opposition to the Bureau of Reclamation retaining control, operation and maintenance of projects after water users' organizations have become legally entitled to take such control.
- Pledging association cooperation with the Bureau of Reclamation and the Corps of Engineers.
- Requesting the association's secretary-manager to send the resolutions adopted to the Congress, governors and attorneys general of the 17 Western States.
- Expressing thanks to the city of Phoenix "for the excellent manner in which all matters pertaining to the meeting have been handled."
- Asking for modification of law to permit the War Department to sell water for irrigation purposes from Army dams without regard to Reclamation law. # # #

Australian Sagebusting Plow

by A. C. Hull, Jr.

Forest Ecologist, Intermountain Forest and Range Experiment Station, Ogden, Utah

EDITOR'S NOTE: As part of a range improvement program, the Forest Service has been conducting tests in Idaho and nearby States in removing sagebrush with a new type of disk plow. Because clearing of sagebrush is a major activity on nearly all new Federal Reclamation projects, we are grateful for this opportunity to publish the latest developments for the benefit of our readers.

Below, the man in charge of the experiments, tells the story.

Photo by Stanley Rasmussen, Region 1

Sagebusting Plow in Action—***Because of unique spring action, each pair of disks can roll over obstacles such as rocks, or brush piles up to 12 inches in height, without supporting any weight of the plow.***

From "Down Under" has come a machine for "plowing under" sagebrush—a major undertaking on great stretches of lands used for range or watersheds or to be cleared for farming.

Until recently, removing sagebrush with the wheatland-type plow has given the best results obtained by mechanical means. This summer some tests have been conducted with a new type disk plow that is promising in several respects.

The Sungeneral stump-jump disk plow has completed three tests near Boise, Idaho, in which plowing and killing of sagebrush on 325 acres of land was accomplished with a high degree of success. This machine was imported from Australia by the Forest Service as part of its research program in developing better machines and cheaper methods for clearing sagebrush and reseeding western ranges.

Present plows used for sagebrush removal are rigid, and when one disk hits a rock or a stump the entire weight of the plow, plus the forward momentum, is thrown on the one disk and breakage often results.

The Australians, who had similar problems, overcame them by mounting disks in pairs on independent arms controlled by springs. The plow was developed to plow saplings and shrubs on land being brought under cultivation. As the tree- or shrub-covered areas of Australia were cut or burned over, the tough roots and stumps were left in the ground. A machine was needed which would tear up the ground, kill the young saplings and brush, and plow through stump, roots and rocks without breaking and clogging. The stump-jump plow did this job well, and in addition it was found to be excellent for plowing good farm land.

The first American test of the stump-jump plow was made in March 1947 on a 20-acre area in the proposed Mountain Home Federal Reclamation project near Boise, Idaho. Most of the area was rock-free, but one corner had loose lava rocks ranging from pebble size to angular rocks 16 inches in diameter. The soil was silt loam and the area was covered with sagebrush which averaged 10 plants per 100 square feet, exclusive of seedlings. Plants varied from less than 1 inch to more than 6 feet in height. Brush kill was very high and is representative of what the plow can do on sagebrush lands. At this location, 40 plots were marked and counted before and immediately after plowing. Sagebrush kill was as follows:

Age groups of sagebrush	Sagebrush plants per 100 square feet before treatment	Percent kill by plowing
Mature	6.2	89
Young	3.8	91
Seedlings	15.6	100
Total	25.6	.....
Average	.....	93

It takes great care with the wheatland plow to obtain as effective removal as this.

The next test was on a 260-acre area where a regular wheatland-type plow had commenced plowing in the fall of 1946. After plowing 100 acres and having many break-downs, the wheatland plow, in good working condition when the plowing commenced, was wrecked and had to be rebuilt. During April 1947 the stump-jump plow covered the remaining 160 acres. Upon completing this tract, an additional 60 acres, which because of rocks had been skipped the previous fall, was plowed. The 220 acres comprised abandoned and waste land supporting weeds and some large brush. The soil was fine-textured and very sticky when wet. Just beneath the soil surface were numerous lava reefs. Striking these hidden rocks caused the regular wheatland-type plow to break. On the other hand, when the stump-jump plow struck these rocks, the individual disks would ride up over them without breakage. A single disk drill was pulled behind the plow on this area and a very good grass-seeding job was accomplished.

The plow was then moved to a heavy sagebrush area with some mountain brush, native grass, and weeds. This area had some rocks and was badly cut up by gullies and ravines with steep slopes. The plow went on any slope where the tractor could go, with 35 percent slope being the maximum at which much work was done. The

plow did an excellent job of killing sagebrush and effectively uprooted and killed brush species such as bitterbrush, serviceberry, snowberry, and young ponderosa pine. It sliced off the thick, tough roots of arrowleaf balsamroot, and killed all other perennial weeds and bunchgrasses.

Uphill Tests Made

However, on hillsides where the disks threw uphill, the rear end of the plow slipped downhill and young brush and tough weeds slipped between the disks. Because of the dishing action of the disks and the better steering of the wheels, it was superior to a wheatland-type plow on sloping land.

The spring action of the disks caused the stump-jump plow to clog less and to break less than wheatland-type plows. The stump-jump plow cleared itself of brush, rocks, weeds, and mud. The only breakage on these severe tests was cracking of the spring lever arms and cracking of the rear wheel, which was chipped during the shipment.

When the plow was ordered from Australia, extra parts were requested to replace those parts which most frequently broke or wore out. The only parts sent were new boxings, indicating that wear and not breakage was the major problem in the rocks and stumps of Australia. The greater ruggedness of the Sungeneral plow is a strong point in its favor.

The plow was pulled by an old HD 7 (60 h. p.) crawler-type tractor. On level land it easily pulled the plow and the drill in third gear at the rate of 3 m. p. h. The operator estimated that the tractor could pull two plows in third gear. On level land it was possible to plow almost 2 acres an hour while on the steeper land it was barely possible to plow 1 acre per hour.

The most distinctive feature of the stump-jump plow is the independent swinging disks mounted with a pitch on jump arms in sets of two. Spring tension holds the disks in the ground when cutting, but when the disks encounter rocks or brush, the spring allows each pair of disks to ride over rocks, or brush piles, up to 12 inches high independent of the other disks. The disks are alternately 20 and 23 inches in diameter, but are mounted on the hump arm with a pitch so that both disks touch the ground at the same time. The pitch of the disks gives them a dishing or sliding action which helps them to maintain a digging depth and kill brush without a corresponding spring tension or heavy weight. The jump arm is in line with the direction of travel. This angle combined with the pitch of the disks allows the disks to release themselves easily when striking rocks.

The depth of cut can be adjusted up to 7 inches. The tests indicated that about 2 inches was most effective when a moderate rate of travel was maintained. The width of cut of the plow is easily adjustable from 6 feet 4 inches to 7 feet 6 inches by changing the steerage of the two rear wheels with a hand lever. The plow was tested at all widths within this range. As the width of cut is decreased, disks acquire more of a slide-under cutting action which is best for removal of sagebrush. The wider cut is good on weeds and on farm land.

This plow is made by the H. V. McKay Massey Harris Co. in Australia, but because of industrial difficulty the plow is not now available. Plows are made in 8-, 12-, and 16-disk sizes. The plow tested was the 12-disk size and weighed 3,000 pounds. Cost in Australia was $413, f. o. b. Melbourne, and shipping and handling charges made the plow cost $601 in Ogden, Utah. Because the plow was an experimental model, import duty was only $6.

The stump-jump plow is a step forward in sagebrush removal. It probably is not the final answer to the mechanical eradication of sagebrush under American conditions. Anticipating the need for improved machinery and methods for reseeding range land, the Forest Service has set up an equipment development program. This plow test is therefore just one of the many methods being tested, and the plow is only one of the many machines being developed for reseeding of range lands. Other parts of the program include the use of sagebrush rails, pipe harrows, broadcasters, brush burners, and other methods.

The stump-jump plow has outstanding features, some of which are now being incorporated into a trial model brushland plow built especially for eradication of sagebrush and similar shrubby species. This work is under the direction of Mr. Ted Flynn at the Forest Service Equipment Laboratory in Portland, Oreg. After thorough testing, this brushland plow will be turned over for commercial manufacture and will be available on the market. It is hoped that this brushland plow will give even better results in the difficult but important job of killing sagebrush. ●

Uncle Sam Says

This is the time of year when the "shop early for Christmas" signs begin to take on meaning which will grow day by day until the happy day actually is here. You could do no better than to put savings bonds at the top of your gift list for someone in your own family circle or a dear friend. U. S. Savings Bonds are truly the gift that is thrice blessed—when it is given, when it is received and when it matures 10 years hence at the rate of $4 for every $3 invested.

U. S. Treasury Department

Big Coulee Generator Starts

Helping to alleviate the threatened power shortage in the Northwest the L–7 108,000 kw generator was put on the line in the Grand Coulee powerhouse the latter part of October.

This brings the actual installed capacity of the power plant up to 776,000 kilowatts with a "peaking capacity" in the neighborhood of 920,000 kilowatts, or greater than the combined power-generating facilities of all plants in North and South Dakota, Delaware, Mississippi, Wyoming, Utah, and Arkansas.

Because of the growing demand for power in the Northwest area the assembly of L–7, first postwar generator to go into service, was accomplished on an around-the-clock schedule. Two more generators of 108,000 kw capacity remain to be installed in the left powerhouse by the close of 1948.

Opening Day at Model Farm

(Continued from Page 261)

others on the speakers' platform, including Miss Helen Noyes, extension economist in home management, Washington State College; H. E. Wichers, extension specialist in rural architecture, Washington State College; District Manager Frank A. Banks of the Bureau of Reclamation; H. P. Singleton, head of the Prosser Experiment Station; James O'Sullivan, whom Thomas called "the Grand Old Man of the Grand Coulee Dam;" J. A. Weber, chairman of the joint board of the three irrigation districts in the project; and J. P. Simpson, member of the State Legislature.

The speeches were short and to the point. The crowd was attentive, but anxious to see more of the crops, to ask more questions about the alfalfa, clover, vetch, and pasture. When the meeting ended, the men started for the fields. The women looked enviously at the modest farm home and read Extension Service circulars describing its plans.

Dusk came early and the families reassembled. Cars and trucks coughed into action and windshield wipers began flicking away at the seldom-experienced rain.

And down to the south the sky began to glow from the lights of the Potholes Dam, where the Nation's fourth longest barrier is being built to impound some of the great volumes of water needed for an irrigation system designed to serve 15,000 family-size farms in the Nation's biggest reclamation project. ●

Taft Visits Reclamation Areas

Senator Robert A. Taft of Ohio, who returned from a Western tour which included visits to the Bureau of Reclamation's Hoover Dam, Imperial Valley, and other Reclamation areas, said during the trip "we certainly must proceed with a public works program, and reclamation in particular has the appealing claim that all of the projects undertaken up to this time are self supporting, so that we can afford to be more generous than with regard to other public works." He concluded by urging "preparation of plans for practicable new projects so they may be available as soon as more funds can be found."

Second Klamath Opening

Secretary of the Interior J. A. Krug recently announced the opening for settlement of the second group of public land farms in the Tule Lake division of the Klamath project, Oregon-California. There will be 44 farm units embracing an area of 3,522 acres. The farms are located in the Coppeck Bay area. Applications for filing will close at 2 P. M. on January 20, 1948.

All applications received during the filing period which began October 22 will be considered simultaneously filed and a public drawing from those who qualify will be held to determine eligibles to enter the farm lands.

Details of the opening and application forms may be obtained by writing to the Bureau of Reclamation, Klamath Falls, Oreg.; Bureau of Reclamation, Sacramento, Calif., or Bureau of Reclamation, Washington, D. C.

Commissioner of Reclamation Michael W. Straus explained that the general regulations under the Homestead and Reclamation laws which have governed previous openings will apply. First opportunity for homesteading, according to law, is given to veterans of World War II who apply before the closing date.

Homestead laws require filing of entry notice and actual residence on the lands within 6 months after date of entry. To get full rights to the land, three years' residence is required. However, credit for military service up to two years may be substituted for a like period of residence.

Each successful applicant in the drawing will be given, free of charge, two barrack-type buildings of the type used for War Relocation Centers, or their equivalent, Secretary Krug added, and certain other property acquired by the Bureau of Reclamation from war surpluses for distribution to homesteaders under Public Law 478, Seventy-ninth Congress. The barracks may be converted into various farm buildings and plans for such conversion have been made by the Bureau.

Entrymen will be required to pay a water rental charge during a predevelopment period of 4 years, after which the irrigation construction charges, under Reclamation law, must be repaid by water users through their organization within 40 years.

Almost all of the homesteaders who received farm lands in 1946 have advanced in their settlement to the point where they now have substantial permanent dwellings and are cropping the lands, the Bureau of Reclamation reported. Mr. Straus added that the record of this area, with no serious crop failure in 25 years, would indicate a good chance for any qualified settler to farm the land successfully.

Platoro Reservoir Approved For San Luis Valley

Secretary of the Interior J. A. Krug recently announced approval of a Bureau of Reclamation recommendation to start construction of Platoro Reservoir on the Conejos River in southern Colorado as soon as repayment contracts are completed by water users in accordance with Reclamation law, as the first stage of a two-reservoir plan to regulate the river.

The Conejos River, a tributary of the Rio Grande, would be developed within terms of the Rio Grande Interstate Compact. Storage on the Conejos is needed, the Bureau of Reclamation reported, to regulate the local water supply seasonally to improve crop production.

Primarily a producer of livestock, with locally raised forage crops used to support the stock, and of potatoes, green peas and other vegetables, the Conejos division comprises 116,200 acres in Conejos County, with average elevation of 7,800 feet above sea level. About 74,000 acres are now irrigated with simple diversion systems, some dating back to 1855, but since no storage is provided, acute water shortages occur both in early spring and late in the growing season. The reservoir will trap floodwaters for use during these periods, and at the same time reduce overflow from stream banks at times when mountain snows are melting.

It is estimated that reservoir storage will make it possible for farmers to double their crop production value per acre.

The two-stage development was recommended by Commissioner of Reclamation Michael W. Straus as the result of additional investigations authorized by the Congress in 1941. The study was to determine whether one or two reservoirs would provide better regulation. Commissioner Straus reported that "storage in Platoro Reservoir will provide adequate regulation for the immediate water needs of the area and will reduce flood damages." The Platoro dam will create a reservoir of 60,000 acre-feet capacity. The Mogote reservoir, with tentative capacity of 30,000 acre-feet, would be constructed later under the two-stage plan, "after the agricultural economy of the area has improved to the extent necessary to justify the need for an additinoal late-season irrigation supply."

Forty percent of the Platoro Reservoir construction and operation costs would be allocated to flood control, and 60 percent to irrigation, as provided when the project was authorized. The Commissioner reported that the Directors of the Conejos Water Conservancy District, representing the farm owners, have approved the plan. The water users would repay irrigation construction costs in 40 years without interest, and pay irrigation operation and maintenance charges annually. The reservoir is expected to reduce the annual flood damages by about 75 percent.

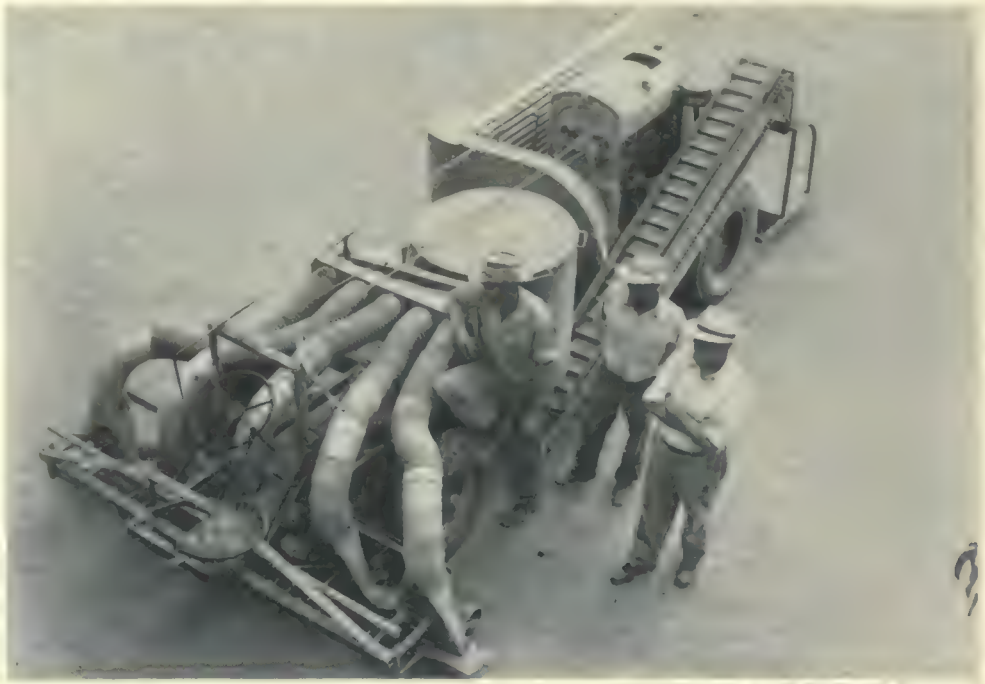
Barbecue Celebration Marks Gila Project

To celebrate the realization of many a pioneer's dream (passage of the Gila project act), some 1,500 persons gathered at the Mohawk Valley schoolhouse in Roll, Ariz., for a good old-fashioned barbecue on November 1.

The enactment of the Gila project bill last July will provide for delivery of water to 75,000 acres of irrigable land in the Mohawk Valley where the communities of Wellton and Roll are located approximately 50 miles east of Yuma.

The celebration was marked by the attendance of many notables including Senators Hayden and McFarland of Arizona, Butler of Nebraska, and Murray of Montana. Also present were Representatives Harless and Murdock of Arizona and Fernandez of New Mexico, Assistant Secretary of the Interior William E. Warne, Commissioner of Reclamation Michael W. Strauss, many other Reclamation officials including Yuma District Manager John K. Roher, and a large NRA delegation.

More Profits for the Almond Producer through *Mechanization*



H. E. Van Till, extreme right, poses with his vacuum almond harvester. With him, left to right, are driver Ivan Bowen, and sacker William Hankins. →

Photo by A. E. McCloud, Region II

No more tedious hand-gleaning of almonds for California's commercial growers of this popular delicacy—a vacuum harvester makes a clean and easy sweep.

Mr. H. E. Van Till, an almond grower on the Bureau of Reclamation's Orland project in California, recently put into operation a suction-type harvester, the latest in a series of continuous attempts to improve the methods of harvesting this crop.

Early in almond harvesting history, the nuts were knocked from the trees and picked from the ground by hand—an unsatisfactory and expensive method. Soon growers began to invent various conveniences. One of these is the widely used almond sled, a long box-like arrangement with attached sheets, similar in operation to firemen's nets. The horse-drawn sled proceeds from tree to tree where the sheets are carefully spread out beneath the branches to catch the almonds as they are jarred or knocked to the ground. They can then be easily gathered up, shoveled into bags, and later hauled to the huller.

Because not all almonds ripen at the same time, growers are faced with problems caused by unripened nuts clinging too tenaciously to the trees, or overripe nuts being blown to the ground by light winds. The new almond gatherer has solved many of these problems and does the job at a reduced cost to the grower.

The mechanical harvester of Mr. Van Till is nothing more than a large vacuum cleaner. It is powered by a 45 h. p. Hercules engine, which provides the mobile power and also drives the large fan which creates the suction. Five suction boxes cut a swath of 117 inches, picking up all loose material from the ground. Behind the fan is a large bin in which the leaves and other debris are separated from the nuts. The unhulled almonds then pass to a conveyer belt which carries them to a platform on the rear of the harvester where they are sacked very similarly to the way grain is handled on a combine harvester.

The driver, who operates the machine, and the sacker are the only crew required. As in the old method of harvesting, the land beneath the trees must be smoothed prior to knocking the almonds.

The harvester of Mr. Van Till at present picks up 300 sacks a day, and after some improvements, it is estimated that it will be able to handle 500 sacks daily. There are several other harvesters similar to this in the process of being manufactured, which will soon be available. •

Salvage Speeds Schedules at Shasta

by **Irving C. Harris, *Construction Engineer,***

Region II, Sacramento, Calif.

More than 375,000 board feet of lumber, made available by using war-surplus equipment and logs salvaged in clearing the Shasta reservoir area, kept the Bureau's Central Valley project construction program on schedule in northern California despite a critical lumber shortage.

In the fall of 1946, construction progress on Shasta and Keswick power plants, tower footings for the Oroville-Sacramento transmission line and other major construction features was threatened by lack of lumber and heavy timber for concrete forms, stringers, caps and other construction requirements until Bureau forces at Shasta dam started pulling rabbits out of their hats.

(The activities described in this article took place prior to July 1, 1947. Ed.)

An ideal sawmill site was found at the old aggregate storage bins a mile downstream from the dam. One bin was converted into a millpond and the first task of a war-surplus Seabee sawmill unit was to draw logs out of it to make the lumber for the 35 by 120 foot structure that was to house it. A locally designed 21 by 35 foot pontoon barge, equipped with a loading and unloading winch, a hoist rig, and driven by a "Sea Mule" propulsion unit, was constructed from Navy surplus pontoons. Logs which would have normally been burned in clearing operations on the Pit River arm of Shasta Lake were then salvaged, loaded aboard, and barged 20 miles down to the dam. Removed from the barge at the dam site, they were trucked to the mill, a mile and a half away. Operated by a small crew of 8 to 10 men, the mill had a capacity of about 10,000 board feet per shift. It was equipped with a 60-inch main saw capable of handling 42-inch logs, a 3-

(Continued on next page)

NOTES FOR CONTRACTORS

CONTRACTS AWARDED DURING OCTOBER 1947

Specification No.	Project and State	Award date	Description of work or material	Contractor's name and address	Contract amount
1901	Missouri Basin, Wyo.	Oct. 1	Construction of superstructures for bridges, relocation of C. B. & Q. R. R., Boysen unit.	American Bridge Co., Denver, Colo.	$528,785.00
1905	Missouri Basin, N. Dak.	do	Furnishing electrical equipment for Beulah and Garrison substations	General Electric Co., Denver, Colo.	16,276.00
1909	Missouri Basin, Mont.	do	Furnishing 20 two-bedroom prefabricated or precut residences for Government Camp, Canyon Ferry Dam.	Green Lumber Co., Laurel, Miss.	53,600.00
1912	Columbia Basin, Wash.	Oct. 7	Furnishing four 1,000 kilovolt-ampere outdoor transformers for Pasco 115-kilovolt substation.	Westinghouse Electric Corp., Denver, Colo.	40,541.00
1913	Missouri Basin, S. Dak.	Oct. 21	Furnishing one 72-inch diameter and one 54-inch diameter outlet pipe, Angostura Dam.	Pacific Coast Engineering Co., Alameda, Calif.	55,100.00
1914	Missouri Basin—power transmission lines, Nebr.	Oct. 31	Construction of Gering-Sidney 115-kilovolt transmission line.	R. N. Campsey Construction Co., Denver, Colo.	210,697.05
1915	Central Valley, Calif.	Oct. 1	Furnishing electrical equipment for Shasta and Keswick Switchyards	Westinghouse Electric Corp., Denver, Colo.	193,306.80
1917	Missouri Basin, Nebr.	Oct. 15	Construction of Cambridge Diversion Dam, Frenchman-Cambridge unit.	J. A. Terteling & Sons, Inc., Boise, Idaho	367,683.50
1926	Columbia Basin, Wash.	Oct. 3	Furnishing circuit breakers and lightning arresters for right and left switchyards, Grand Coulee power plant.	General Electric Co., Denver, Colo.	1,520,208.00
1928	Colorado-Big Thompson, Colo.	Oct. 28	Furnishing one 50-ton and one 25-ton traveling cranes for Granby pumping plant.	Cyclops Iron Works, San Francisco, Calif.	75,066.00
1930	Boise, Idaho	Oct. 27	Construction of concrete check, Black Canyon Canal.	Vernon Brothers Co., Boise, Idaho	28,118.50
1941	Lewiston Orchards, Idaho	Oct. 10	Construction of Webb Creek Diversion Dam and concrete diversion pipe.	Hansen and Parr Construction Co., Spokane, Wash.	50,011.75
1942	Missouri Basin, Mont.	Oct. 13	Furnishing structural steel, siding, doors, windows, etc., for warehouse, Canyon Ferry Government camp.	Caird Engineering Works, Helena, Mont.	18,496.56
1951	Hungry Horse, Mont.	Oct. 30	Excavation for diversion tunnel, Hungry Horse Dam	Guy F. Atkinson Co., South San Francisco, Calif.	643,400.00
1967	Central Valley, Calif.	Oct. 24	Construction of 230-kilovolt transmission lines, Shasta to Cottonwood-Gas Point Road and Keswick tap lines.	Abbott Electric Co., San Francisco, Calif.	587,383.00
2-R1	Minidoka, Idaho	Oct. 11	Earthwork, lateral lining, and structures for laterals	Duffy-Reed Construction Co., Twin Falls, Idaho	91,670.50
3-R1	Deschutes, Oreg.	Oct. 22	Construction of Cove Power Plant diversion dam	Alder Construction Co., Madras, Oreg.	24,420.00
A-7091-A	Davis Dam, Ariz-Nev.	Oct. 20	Furnishing aluminum conductor for Davis-Hoover and Davis Prescott-Phoenix 230-kilovolt transmission line.	General Cable Corp., Kansas City, Mo.	803,014.37

CONSTRUCTION FOR WHICH BIDS WILL BE INVITED DURING DECEMBER 1947

Project	Description of work or material
Boise-Payette, Idaho	Construction of earthwork and structures for Sand Hollow wasteway.
Do	Construction of earthwork and structures for Willow Creek wasteway.
Boulder Canyon—All-American Canal, Calif.	Construction of structures for distribution systems in East Thermal and North Indio areas, Coachella division.
Do	Construction of Wasteways Nos. 2 and 3 for flood protective works, Coachella division.
Central Valley, Calif.	Construction of earthwork, lining, and structures for 14.5 miles of Friant-Kern Canal.
Do	Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.
Do	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colo.	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on Big Thompson River, a 1-mile tunnel, 12 concrete siphons, and 1 steel siphon.
Missouri Basin—Frenchman-Cambridge, Nebr.	Construction of earthwork and structures for 12.5 miles of Cambridge Canal.

NEXT MONTH

What Causes Gullies? **Is man responsible for the vast eroded badlands of the West, or is Mother Nature to blame? Geologist H. V. Peterson of the Geological Survey presents the latest findings on these and other pertinent questions.**

ALSO *How To Conserve Irrigation Water Supplies*, by L. R. Fiock, Superintendent of the Rio Grande project in New Mexico-Texas.

Our Back Cover

Cottonwood Creek, Idaho

Today's snow=next season's irrigation water supply. This scene of the Boise National Park area shows Cottonwood Creek on its way to Arrowrock Reservoir which stores irrigation water for the Bureau of Reclamation's Boise, Idaho, project.

The photo was taken by Phil Merritt, Region I

(*Continued from page 268*)

saw edger, a cut-off saw, and a 30-foot set of live rolls.

The need for the mill can best be realized when you consider the vast quantity of heavy timber and lumber required in framing, sheathing and shoring concrete forms and in providing walers, segments, etc., illustrated by the requirements for the three draft-tube forms for Keswick Power Plant. Each draft-tube form required 30,000 board feet of lumber—a whole carload. In embedding these forms, and in subsequent concrete operations, more than 2,500 cubic yards of second-stage concrete for Keswick Power Plant have been placed according to schedule.

Likewise in Shasta power plant, where two 75,000 kilowatt generators, loaned to Grand Coulee for 33 months during the war, are being installed, large quantities of lumber are required. For instance, unit No. 5 alone took more than 55,000 board feet of timber and lumber. Similarly, work on Unit No. 2, the other installation being made at the present time, requires large quantities of lumber, much of it in large dimensions. Despite these heavy demands, work is proceeding in an orderly and scheduled manner although lumber shortages in the market still continue.

These major construction features can move along only if a host of minor related features are completed according to schedule. For example, the lack of the relatively small quantity of 30,000 board-feet of lumber would have delayed the building of Shasta switchyard footings or steel tower footings on the Oroville-Sacramento 230-kv transmission line now under construction by the Bureau. In addition, lack of lumber for bridges, access roads, scaffolding, ladders, etc., would have made smooth coordination and integration of over-all construction progress quite difficult.

But once again, "Joe McGee" did the job.

In the final month of operations the sawmill produced 116,330 board feet of lumber and timbers of various dimensions for use on the project. ●

U. S. GOVERNMENT PRINTING OFFICE: 1947

Cottonwood Creek, Idaho

Bureau of Reclamation Photo

JANUARY
1948

Featuring:

- **The Gully Problem**
  by H. V. Peterson
- ***Irrigation in Australia***
- **Date Festival—**
  Below Sea Level

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THE Reclamation ERA

Weed Resolutions—1948

"Out of sight out of mind . . ."

Some New Year's resolutions may be made to be broken—but not those that actually affect our welfare. Resolutions which will save an irrigation farmer money are those he vows he will be sure to keep this year regarding weed control.

Such resolutions are easy to make while fighting weeds during the summer months.

But sometimes the old "out of sight—out of mind" psychology creeps in and during the winter, when the weeds are not seen, it is easy to forget the extra work that had to be done, the extra irrigation water used, the extra wear and tear on equipment and the extra costs in harvesting and marketing the crop.

Also, by spring, some of the edges of shock and disappointment caused by the actual loss of income due to reduced crop yields and dockages for lower crop quality due to weed competition, are worn off.

Spring is an optimistic time of year when a true tiller of the soil's fancy lightly turns to fields of waving alfalfa and sturdy sugar beets.

But just do not forget all those ornery little wriggling roots and those millions of seeds just waiting until the back of your mind is turned to send out shoots and strangle your pocketbook.

That sounds like the worst kind of pessimism but it need not happen if you make and keep your set of weed control resolutions.

Make them now while all the trials and tribulations of weed fighting last summer are still fresh in your mind—and then do not forget to review them in the spring.

Keep them where you will be sure to see them, where they will remind you that instead of being just a bed of roses, farming may become a bed of morning glory or

(Continued on next page)

Reclamation ERA

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Ruth F. Sadler, *Editor*

Our Front Cover

The Golden Experiment

Art Willis, the determined looking chap on the cover, is a homesteader on the Bureau of Reclamation's Yakima-Roza project in the State of Washington, having won an irrigated farm in last summer's drawing. However, it took will power and an estimate of irrigation values to enable him to leave a 320-acre dry-land farm in Kansas for the smaller irrigated farm he calls "The Golden Experiment." This portrait was taken by Chief Photographer Stanley Rasmussen of Region 1.

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United States Department of the Interior,
Washington 25, D. C.

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"The Water Must Be Delivered"

A great deal has been written concerning the loyalty and devotion of employees in certain occupations. In the theatrical field the motto is "The show must go on"; the Post Office uses the motto "The mails must go through." The Bureau could well use "The water must be delivered," for its employees display the same loyalty and devotion to duty, and experience hardships comparable to those encountered by employees in the more publicized occupations.

On the Riverton project this is brought forcefully to mind during the winter months when it is necessary to combat the elements in order that the Pilot Butte power plant be supplied with power water. The water for the power plant is diverted at the Wind River Diversion Dam into the Wyoming Canal whence it flows 9 miles in an open channel to a forebay above the power plant.

With temperatures running as low as 45° below zero at times, and staying below zero for weeks at a stretch, a great deal of ice of various kinds is formed. Channels must be kept open if water is to flow. To keep these channels open, men must be on duty throughout each 24-hour period, cutting ice with ice saws, guiding large blocks of ice through spillway channels, and doing other jobs calling for skill and ability to withstand extreme cold and physical discomfort.

At times the task seems hopeless, but the fight still goes on. In spite of the hardships, the men stick to their work and the power plant operates. The men performing these services are not supermen employed for their exceptional stamina, or love of a fight against obstacles, but are, for the most part, ditchriders and others who operate and maintain the irrigation system during the more pleasant months of the year. Too much credit cannot possibly be given these men for their loyalty and devotion to duty—and that extends from the highest to the lowest. It is only through the courage and everlasting persistence of these men that the Pilot Butte power plant has so successfully operated every winter since the first energy was generated in January 1925. •

Everyone a Builder

This magazine is devoted to the reclamationists of the West. It is designed to bring profitable information and interesting facts to you. It can bring similar pleasure and profit to your friends, neighbors, or relatives who do not yet receive it. The price is nominal—$1 a year. If you are a member of a western water users association, the price is only 50 cents a year. You need allies in building prosperity for yourself and for your neighbors. Help build the circulation of the RECLAMATION ERA and add to the number of informed proponents of western water resource development.

United States Department of the Interior

J. A. Krug, Secretary

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Weed Resolutions

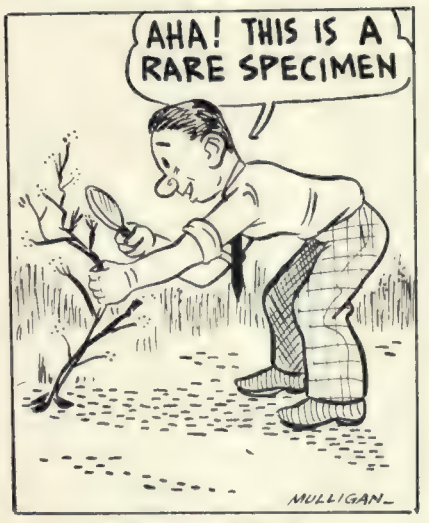
(Continued from preceding page)

Canada thistle. How about hanging them on the barn door? (The resolutions—not the weeds.)

Here is a set you may want to consider. You will probably want to add a few of your own.

RESOLVED:

1. To start weed control operations early so I can keep ahead of the weeds.
2. To learn to identify noxious weeds so I can control them before they become a large patch or spread to other parts of the farm.
3. To buy clean crop seed so I won't actually be planting weeds.
4. To encourage my irrigation district to appropriate sufficient funds for proper weed control on ditchbanks so this source of infestation to my farm is eliminated.
5. To encourage seeding of ditchbanks with weed-competing grasses.
6. To encourage pasturing of ditchbanks to help control weeds which, if left to mature, may send seeds to my farm by the water route.
7. To see that threshing and other equipment is thoroughly cleaned before it enters my farm.
8. To use every other means possible to prevent weeds starting on my farm.
9. To investigate new methods of control such as the use of 2, 4-D to see how I might be benefited.
10. To help in the formation of a weed district or to cooperate with weed districts.
11. To plan a real weed control campaign on my farm.
12. To carry the plan out, and *last but not least*
13. To keep these resolutions. •



Resolution No. 2

The GULLY Problem

By H. V. PETERSON, Geologist, United States Geological Survey

Gullies form one of the most destructive and certainly one of the most spectacular types of erosion to be found in many western areas, particularly in the Southwest.

These deep incisions, bounded by ragged, caving, and almost vertical walls have, for many years, been eating insidiously mile after mile through the heart of numerous broad flat valleys that once formed some of our most productive range lands. Headcuts that ordinarily appear to be nothing more than harmless drops in a dry or nearly dry stream channel are converted to veritable raging waterfalls during flood periods and with the enormous cutting impetus imparted by a 5- to 30-foot drop, extend the gully upstream with surprising rapidity. Examples of gullies eating headward several hundred feet during a single storm lasting no more than a few hours are not uncommon.

Once the main stream becomes entrenched in such a channel, the tributaries are temporarily left at their former elevations. The waterfalls formed by the drop rapidly undercut the bed of the tributary which then is progressively entrenched upstream. Myriads of side headcuts are thus developed, each progressing outward whenever run-off from side drainage occurs.

Secondary headcuts along the tributaries in turn develop, the final result being such a maze of gullies that level terrain is converted to typical badlands. In some localities badland belts several hundred feet wide are conspicuous features of once smooth valley floors.

To the physiographer and the student of the earth's weathering cycle, the presence of a gully is evidence of an unbalanced condition between the processes of sedimentation and erosion.

To the cattleman, the farmer, or the administrator concerned in obtaining the greatest measure of productivity from the land, it represents a destructive force that has already taken a heavy toll from the land's potential forage or agricultural yield and one that, if allowed to continue at an accelerated or even the present rate, will eventually destroy much of the productivity of our western range.

Every gully of appreciable depth forms an effective drain causing a drop in the ground-water level, which thus deprives plants of their life-sustaining moisture. Thus a familiar accompaniment of gullies in many localities is the belt of barren land extending back from the headcut area where the plants have withered and died, leaving bare soil exposed to the elements. Some of these belts are but a few feet wide, others are several hundred, but each is expanding.

But the loss of range forage resulting from gullying represents only a part—possibly a minor part—of the total harm which can be attributed to erosion of this type.

More critical than depletion of the range is the actual and potential contribution of silt from these denuded areas—silt which, unless control measures are instituted, will move in constantly mounting quantities into the major streams to fill reservoirs, to clog natural stream channels and irrigation canals, and eventually to blanket rich farm lands with a sterile impervious coating.

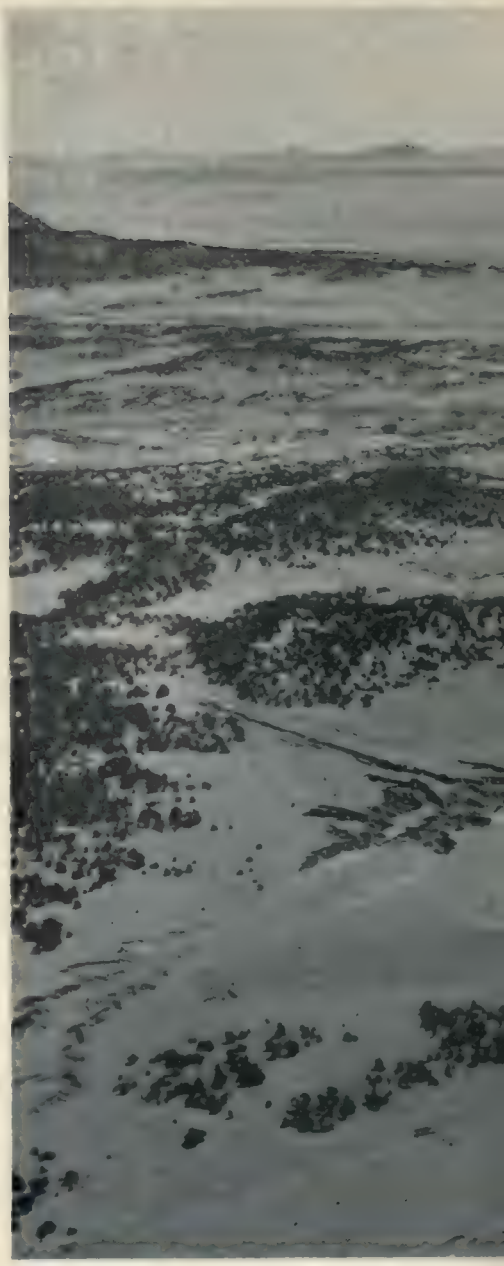
Only a casual examination is needed to show that the principal sources of silt in many large stream basins are these gullied tributary valleys, and already in some localities farmers prefer to bypass the run-off from these tributaries on the grounds that an irrigation with such silt-laden waters is not only valueless but harmful to the land. The problem thus involves more than destruction of range forage, it affects the entire land economy of the arid and semi-arid west.

What Causes Gulleys?

What caused the unbalancing of nature's forces and instituted the cutting cycle is a controversial subject.

It has been suggested in some quarters that parts of the western area may have been subjected to regional uplift, thereby increasing the stream gradients and greatly augmenting the stream's ability to erode. There is little, if any, direct evidence to support this theory and considerable to disprove it.

Another theory advanced is that of a changing climate. Advocates of this idea contend that even a slight reduction in the amount of annual precipitation or minor shifting in its distribution would be sufficient to upset the delicate balance between erosion and deposition. They point to the protracted droughts and the severe floods experienced in recent years as conditions that foster and stimulate rapid and destructive channel cutting. The paucity of long-term weather records in the West makes it impossible to prove or disprove this theory or to show that climate during the past 50–70 years differed from or was more



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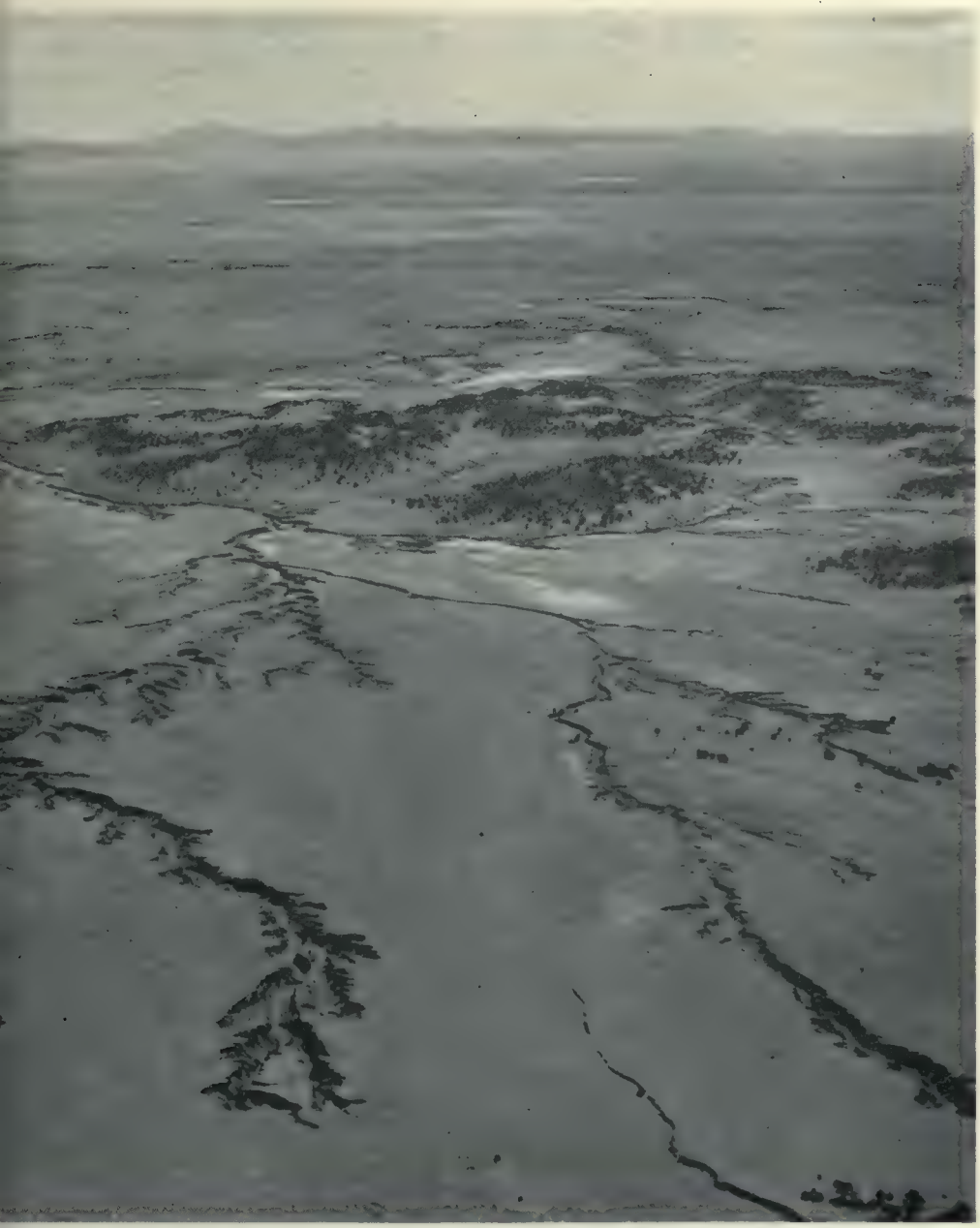


Photo by Dale A. Hovey, former Region V photographer

ullies ravage New Mexico terrain as shown in the foreground of this aerial photo.

severe than during that prevailing previously. Nonetheless climatic changes cannot be ignored as a possible cause of the cutting, particularly in view of the findings resulting from close examination of some alluvial valley fills which show evidence of previous cycles of erosion, difficult to explain other than by changes in the amount and distribution of precipitation.

Probably the most widely accepted reason for the channel cutting, and certainly the most publicized one, attributes the cause to man's abusive practices.

Overgrazing is consistently pointed out as the most serious of these abuses, although several other practices are listed as important contributory features in starting the cutting cycle.

Early settlers are accused of locating roads and ditches without consideration of their effect on the drainage aspect of the areas. Their herds were allowed to concentrate along the valley floors where the feed was lush and range water was easily provided, while more remote areas, where water was difficult to obtain, were left untouched. Thus overgrazing was particularly aggravated in these vulnerable spots.

Stock trails likewise followed the more accessible valley bottoms and trailing herds tramped out vegetation and left the soil scarred with deep rutty trails, thus affording an ideal condition for concentration of flood flows and initiation of erosion. In a few cases it is known that settlers, in order to overcome the nuisance of shallow flood water passing over their land, build channels and dikes to drain off the flow. This was often sufficient to start the gullying.

Unfortunately there is little that can be said in defense of many of our early land-use practices.

In spite of repeated warnings from competent and conscientious observers and students of land utilization, the early West was developed mainly on the theory that our land resources were unlimited. What matter if gullies threatened to cut the heart from a few hundred square miles of grassy valley lands when there were millions of acres and scores of other valleys beyond the horizon? Not until the erosion problem became critical in many sections of the country did we come to the realization that our limitless frontiers had vanished and that henceforth it would be sound business to conserve what was left.

In a few instances the beginning date of the gullying is known. According to testimony of living witnesses, trenching in the San Pedro River, a tributary of the Gila River in southern Arizona, began with the tremendous floods that occurred during the summer of 1881. (The few rainfall records available indicate that this was by far the wettest summer season ever recorded in that part of the State.) Ten or twelve years later the headcut had eaten headward 125 miles and created one of the worst erosion problems in the Southwest.

The San Simone Wash, another tributary of the Gila, draining parts of southeastern Arizona and southwestern New Mexico, started in 1881 or 1882 but never became serious until the flood year of 1904–5. By 1920 it had trenched 60 miles headward, laying waste a range many square miles in extent that is reported to have once been one of the best in southern Arizona. Fifty thousand head of cattle are said to have grazed in the San Simone Valley in the eighties, whereas today it supports less than one-tenth of that number.

Valleys in northern Arizona and southern Utah are believed to have been incised slightly earlier, possibly in the late seventies and early eighties.

There is evidence that the Rio Puerco, a south-flowing tributary of the Rio Grande in central New Mexico, was gullied to some extent as early as 1846 but by the late eighties settlers were having difficulty maintaining dams of sufficient height to divert flood waters from the deep channel onto their adjoining farms. Today the channel is from 20 to 50 feet in depth and the farms have been abandoned.

The beginning of trenching in Kanab Creek, Utah, is definitely placed as July 1883. Other streams in this general vicinity probably began cutting somewhere near this date, although it is rather definitely established that they were not all influenced by the same series of storms and did not begin cutting at identical times.

It would appear to be no coincidence that gullying started in most valleys within a few years after the white settlers arrived and with this array of evidence it is difficult to absolve them of blame for starting it. But even so the case is not conclusive. That erosion occurred before this arrival is shown by the outlines of buried channels,

exposed in existing gully walls, evidence that former cycles of erosion not unlike those of the present day have occurred. These channels were cut long before domesticated livestock were present in sufficient numbers to deplete or destroy the natural vegetative covering of the range.

In numerous valleys older river terraces parallel present stream channels, sometimes occurring as steps one above the other. They represent final stages of former channel cutting, each of which probably started as a gully. The remains of former mud flows, many of them now solidified into rock, are found in many localities, mute testimony of the erosive power of violent floods of the past. Even modern observers have described gullies in areas where cattle have never grazed.

With so much controversial evidence involved it is doubtful if any one item or set of circumstances can be assigned as being directly responsible for the development of gullies.

The most plausible and consistent theory of initiation would appear to involve both climatic changes and land misuse, the latter acting as a trip to upset a delicate balance just able to maintain itself in a climate possibly growing slightly drier with drought periods appearing more frequently and with greater severity.

But, one may argue, of what concern is the cause when the damage is already done? With valley after valley being cut out by these networks of gullies, are we not literally in the proverbial position of trying to lock the barn door after the horse has been stolen? In some measure this is correct.

The problem has been neglected too long but there is still opportunity for correction.

In this respect diagnosis for prescribing a remedy is necessary and to this end typical gullies in various locations throughout the West are being studied with a view of obtaining every shred of evidence which relates to their genesis and which might be turned to advantage in designing corrective measures.

Geologists—for erosion is a geologic process as old as the earth—direct their search to the gully banks and other outcrops in an effort to unravel the history not only of present and past periods of erosion but of the intervening periods of alluviation when nature's processes were reversed.

- How often have these reversals occurred?
- Were they of local or widespread extent?
- Can the periods be correlated from one area to another, indicating widespread and significant changes in climate or perhaps other conditions?
- Where did the sediments come from?
- How did they arrive, by wind or water?
- What changes occurred in transit?

These are some of the questions for which answers will be sought.

Geologists look for these answers in such features as the size, shape and positions of buried stream channels, evidences of a past temporary reversal from erosion to deposition, variations in character of the sediments, etc., just as historians search ancient documents for an accounting of man's past activities.

To supplement geologic data, information from other sources is being gathered. For example, mixed with the sediments in many localities are artifacts, potsherds, and other relics of human habitation showing that former populations also had their erosion troubles.

Archaeologists can identify and date many of these items and furnish information on the culture and living habits of these people. It is entirely possible that even our enlightened generation can learn much from the experience of these crude prehistoric inhabitants.

Studies of buried soil layers likewise offer a fruitful field of research for the soil scientist in unraveling the complex history of these areas. Some horizons represent swampy conditions associated with high precipitation, others arid or semiarid conditions perhaps similar to those existing at present. If a relationship between erosion and these soil types can be established, an important step in approaching the cause of erosion will have been taken.

In the meantime other aspects of the problem are receiving their complement of attention.

Overgrazing is being eliminated through regulation and by better distribution of livestock accomplished largely by providing additional range water facilities. Stockmen generally accept this regulation with enthusiasm for they see in it the prospect of better ranges, better beef, and better profits for their operations.

But, unfortunately, once the gullies are established, regulation or, in some localities, even the elimination of grazing is inadequate to stop the headcutting. Nature under these circumstances must be given assistance in the way of structural treatment. Thus engineering plays an essential part in the investigation.

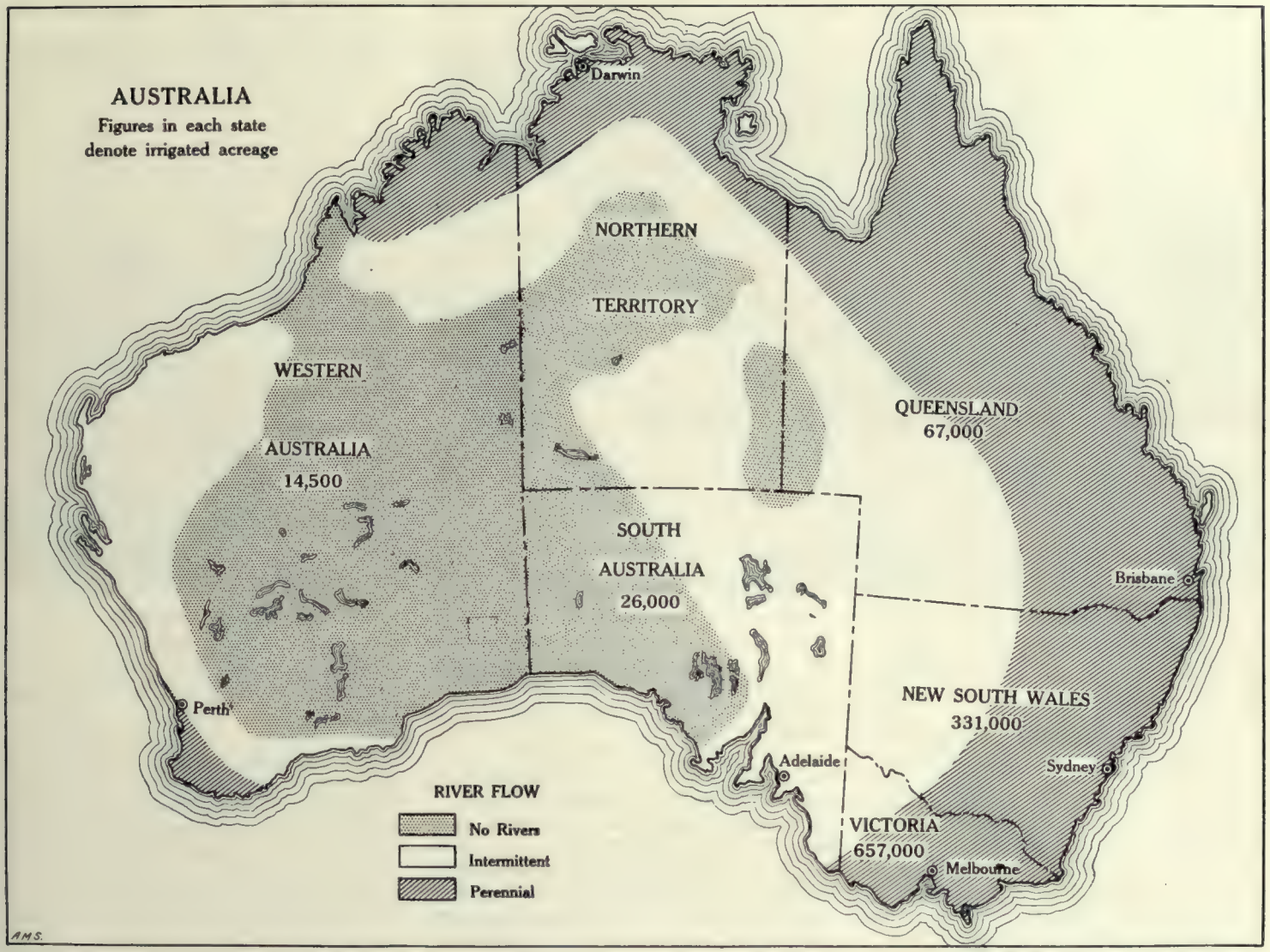
Engineering phases of the problem include studies on hydrology as it relates to flood run-off and to the dynamics of silt movement, the effectiveness of structures of various sizes and design located at various positions within the drainage basin in controlling headcutting and in causing deposition within existing gullies.

Closely associated with these investigations, archaeologists and plant technicians are studying the role of vegetation not only as a weapon in combatting erosion and gully cutting but also as a means of improving the range.

Thus efforts are being directed toward an integrated program of investigation with no phase being overlooked. Technicians from many Government agencies enthusiastically aided in many cases by local land owners, stockmen, private engineers, and others interested in conservation are participating. So complex and so widespread is the problem of gully control that it is going to require their best efforts to formulate a solution. •

NATURE'S UNBRIDLED EXCAVATOR *goes to work: on the left, "badlands" along the fringe of the San Simon Gully, Ariz., at center, headcut at Henry's Lake, Idaho, and on the right, the Malpais Arroya in New Mexico that resembles a miniature Grand Canyon. Two outside photos by Geological Survey, center photo by S. R. Marean, Region 1.*

Irrigation in AUSTRALIA



Map by Drafting and Graphics Section

by Lester A. Robb

Engineer, Office of the Engineering Assistant

(The following article is based on information made available by Mr. G. M. Gray, Agricultural Attaché, Australian Embassy, Washington, D. C.)

The importance of irrigation in relation to the wealth and prosperity of a nation has long been recognized in Australia.

Though this country "down under" is well known to every school child as the home of the kangaroo and the bushman with his boomerang, more important things than these contribute to the fame of Australia today, and among them is the ever-growing practice of irrigation.

Australia has an area of approximately 3 million square miles, slightly less than that of the United States. It is, however, more comparable, both as to geography and climate, with northern Africa. Australia, the most arid of all the continents, has an average yearly rainfall of only 17 inches. This, however, is not evenly distributed—38 percent of the country receiving less than 10 inches per year. In contrast, only 7 percent of the area of the United States has less than 10 inches of annual rainfall. Australia's population is concentrated in the coastal regions of greatest rainfall and in vast areas of arid and semiarid lands which continue to wait the coming of water which will only be made available if means can be found of conserving the precious flood waters which infrequently fall.

When the first agriculturists settled in Australia, they began to find that their pastoral and agricultural occupations were handicapped by uncertain rainfall and recurrent droughts. It was only natural for them to begin to think of reinforcing the natural rainfall by supplies of water obtained by other means. The State of Victoria has the distinction of being the State where irrigation was first practiced in Australia. It has since continued to lead the other States in amount of land irrigated (see map) and all of the States have followed quite closely the plan of irrigation development adopted by Victoria.

From its early beginning in the 1870's, irrigation has spread from valley to valley wherever water may be stored and diverted, so that now more than a million acres of Australian land are under irrigation. Although this figure is small compared with irrigated acreages in the United States, and while it represents only a minor portion of all cultivated lands in Australia, more and more water is being made available each year so that Australia is rapidly becoming one of the great irrigated nations of the world.

Australia has long been recognized as the largest wool-producing nation in the world and, as such, has encountered some resistance on the part of sheep raisers against the development of irrigated lands in certain areas. This resistance has not perceptibly affected the growth of irrigation, however. The chief irrigated crops at present are lucerne (alfalfa), grasses, and green fodder

Australian News and Information Service Photo

Western Australian Goldfields Reservoir at Mundaring on the Helena River is world renowned. Water is pumped 375 miles through 32-inch steel mains to Kalgoorlie.

which account for about 35 percent of the total; cereals account for another 25 percent, and the remainder is represented by orchards, vineyards, and truck produce. Considerable areas of pasture land are also irrigated each year. Irrigated pastures may amount to as much as 500,000 acres, but this acreage is not included in the figures shown on the accompanying map nor is it included in the total of irrigated acreages mentioned above.

The first irrigation schemes were private affairs developed on individual holdings. Later, larger scale district schemes were developed, particularly along the River Murray, Australia's largest river, whose basin embraces practically all of the State of New South Wales and large portions of Victoria, Queensland, and South Australia.

While many of the early irrigation attempts were remarkably successful, fully as many failed completely. Most of the early failures were due to several contributing factors. Often the land irrigated was not particularly suitable, methods employed were sometimes extremely crude and many farmers did not recognize that an irrigation district scheme involves its members in a liability to pay their share of charges even in seasons when they do not want the water, as well as in the drier years—a condition which often exists in the more humid coastal regions of Australia.

In Victoria the unsatisfactory financial position of these schemes led to the Government taking most of them over and setting up a State body to deal with irrigation matters in 1905. Previous legislation in this State had provided for the advancing of Government funds for certain water supply purposes.

The Water Act of 1905 abolished all the irrigation trusts in Victoria, excepting one, and created the State Rivers and Water Supply Commission to take over complete control of rural water supplies generally in that State. Another feature of this act was the declaration that the bed and banks of all streams should become and remain the property of the Crown. This completed the nationalization of streams and other natural resources of water supply in Victoria commenced by earlier legislation in 1886.

In Victoria, at the present time, no one has a legal right to water except where authorized under the various water acts.

Further legislation was provided through the years, and in 1909, "compulsory" water rights were introduced to compel payment for water in irrigation districts whether it was used or not. This law was designed to provide a permanent financial return to the State and to insure full utilization of the land to which the water right applies. Provision for flood protection works and drainage was made in later legislation so that these two items have played an important part in recent developments.

The next big step forward in water supply policy was taken in the adoption of an act in 1937. Under this act, the entire cost of flood protection and drainage works was nationalized and a substantial part of the cost of rural water supply and irrigation works, including headworks and main supply works, was transferred to the State. This step was taken when it was realized that the ideal of the water users bearing the full cost of constructing and operating works could seldom be attained.

In Victoria the State has had to accept responsibility for four-fifths of the capital costs of all irrigation works constructed.

Generally speaking, the rates and charges which the water users are required to pay are such that the surplus revenue over operation and maintenance costs is sufficient to meet interest and redemption charges on only one-fifth of the capital cost of the works. Including operating and capital charges, it can be said that for every dollar the water user is required to pay, the State contributes $2, which, of course, is met from general funds of the State.

It is generally felt, not only in Victoria, but in the other States as well, that the financing of irrigation by the State is the logical mehod. It is felt that the whole State and Nation benefit from irrigation developments in such forms as increased productivity and the general improvement in employment which the resultant trade provides. As roads and communications benefit the Nation as a whole, so do the irrigation, flood control, and power developments. Recognizing that the future economy of Australia depends greatly upon the conservation and utilization of its water resources, it is natural that they should be treated as a public works. Certainly the increased agricultural productivity has fully justified the expenditures of State monies made to date.

On the other hand, such a system is not entirely without its faults. There are those who do not feel that the general taxpayer should bear a portion of the expenditures that more directly benefit certain relatively small groups.

It is also at times difficult to select a "yardstick," so to speak, to determine the justification for carrying out a new project in which the water users would be expected to pay only operating costs.

It has also been observed that heavy capital expenditures on dams, pipelines, and concrete-lined canals can reduce water distribution and maintenance costs to a minimum. This means that the revenue from water rates which are based on maintenance and operation only are very low, while the interest and redemption costs to be met by the State are very high. There is thus no real relationship between cost and benefit as far as the water users are concerned.

However, plans similar to those of Victoria are now in effect in all of the States and they have proven to be the most satisfactory all-around systems devised to date. No doubt these systems of financing will be changed from time to time in minor details, but it is doubtful if the water users will again be required to pay for the major portion of capital costs. Their share may possibly be increased slightly but considering the present concept of irrigation in Australia and the important part it is expected to play in the future, undoubtedly irrigation development will continue to be a function of the State and Nation as a whole. ●

READ *Impressions of China* in next month's RECLAMATION ERA by Constantin P. Christopoulos Professor of Hydraulic Engineering and UNRRA Conservancy Advisor for North China.

DATE FESTIVAL
Below Sea Level

Ride 'em, Sheriff! Novel camel race adds to color of Riverside festival. *Photo courtesy Hartman Photos, Indio, Calif.*

by Hubert M. Williams

Engineer, Coachella Division, All-American Canal System, Region III

One of the first and most unique fairs of this year will be the Riverside County Fair and Date Festival, being held at Indio, Calif., February 11–15.

Staged in the heart of the Nation's date country—the Coachella Valley—the event has not only the unique distinction of being the only known date festival in the world but it is also held below sea level. Some ranches at the lower end of the Coachella Valley, near Salton Sea, are located about 220 feet below sea level while a few ranches in the northwestern portion of the valley are in an area which is 220 feet above sea level. The site of the Riverside County Fair and Date Festival is located approximately 10 feet below sea level, just outside the city limits of Indio, Calif.

The theme of this year's date festival, like that of last year, will be built around the Arabian Nights motif. Visitors from near and far will enter through mosque-like gates, designed in authentic Arabic architecture and decorated with Arabic and English greetings, and will go past Arab sentries into grounds where a carnival-like atmosphere will prevail. Near-eastern costuming, decorations and music will lend color and atmosphere to the occasion.

Cities throughout Riverside County have entered contestants in a queen contest in which the winning contestant will be crowned "Queen Scheherezade" the opening night of the fair on the large new outdoor stage. Queen Scheherezade, with the remaining contestants as her attendants, will then rule throughout the festival. Each night the queen with her attendants will present a pageant depicting a different Arabian Night's tale.

One of the most colorful and spectacular features of the entire festival will be an Arabian parade staged in downtown Indio on February 12. This year's parade, like last year's, will be led by the California Highway Patrol and a color guard from the R. O. T. C. unit of the Riverside (Calif.) High School Band. There will, besides the queen's float, be more than 200 entrants. Equestrian groups, colorful floats, and Arabian costumes will be featured in the parade which will be over four miles long.

During the 5-day period of the fair, there will be a Desert Citrus Institute which will be held at the Coachella Valley High School in connection with the fair. Daily lectures on desert agriculture will be conducted in cooperation with the University of California Agriculture Extension Service. Mr. H. L. McFarlane, county farm advisor, will have a "questions and answers" exhibit where he and members of his staff will give useful advice and answers to questions on farm matters.

As the Coachella Valley produces ninety percent of all dates grown commercially in the United States, the story of date culture will be featured for the benefit of the visitors. Drawing unusual interest will be the many date and citrus exhibits entered by local growers, packers and shippers, wholesalers and retailers. The growth of the date from blossom stage to one of many packs for shipping, will be shown. Samples of male and female blossoms, with examples of various pollination methods, will also be shown. Different varieties of date trees are planted throughout the fair grounds with samples of different offshoots that have been removed from parent trees to start new gardens. There will be exhibits showing different varieties of dates, some that must be hydrated before using and others that have to be dehydrated before they can be used.

In preparation for this year's fair festival, close to $125,000 has been spent on capital investments. This amount was allotted to the fair committee by the State of California from funds received from the 4 percent levy on thoroughbred race track wagering in the State of California. This amount has been spent on a new exhibit building, grandstands for the outdoor arena, and for facilities to handle 250 head each of horses, cattle, swine, and sheep.

Each afternoon during the 5 days of the fair, there will be a horse show and circus acts in the outdoor arena. The response to last year's camel races was so enthusiastic that again this year they will be featured every afternoon. Members of the Riverside Sheriff's Posse help to make this event one of the feature attractions of the entertainment portion of the festival.

This year's fair and date festival is the second to be held since 1941. Last year's event broke all previous records for attendance with 29,351 paid admissions, the previous high being 8,700 in 1941. The festival has been lengthened 1 day this year and it is expected again to break all attendance records.

Photo courtesy M. D. Bradshaw, Thermal, Calif.

Atmosphere of Middle East prevails at Riverside as fair and festival get under way.

Photo courtesy Hartman Photos, Indio, Calif.

A FAIR attraction surrounded by some of the luscious products of the Coachella Valley.

The first of many date festivals was held October 23, 1921. This and succeeding festivals were held in a large tent near Indio, sponsored by a number of date growers of the Valley. In 1938 a county fair was held in conjunction with the date festival, and the Indio Civic Club arranged with the county board of supervisors to hold county fairs during the years 1938–41. The county supervisors handled last year's event and will be in charge of the festival this year. The county of Riverside has set up a revolving fund of $22,000 for operating expenses. However, last year's event showed a slight profit.

Future plans of the fair committee call for the construction of additional exhibit buildings, a larger arena and grandstand.

At present there are approximately 20,000 acres of cultivated lands in the Coachella Valley, irrigated by wells alone, with about one-fifth of this acreage planted to dates. Upon the completion of the Coachella Canal and distribution system by the Bureau of Reclamation there will be a total of 77,000 acres of arable lands subject to irrigation. With this expected large increase in date plantings, the date industry will play an even more important part in the economic future of the Coachella Valley.

In the years to come the Riverside County fair and date festival, keeping pace with the rapid growth of the desert area, should be a great asset to both the county and to Coachella Valley and prove to be an event which will be one of the outstanding affairs of its kind. ●

Report on Bureau Conservation Conference

Last November, Reclamation's operation and maintenance supervisors discussed problems of soil and moisture conservation with representatives of project planning and other Bureau and Interior Department staff members.

Every Reclamation project may eventually lose its usefulness—perhaps hundreds of years hence—unless conservation methods and new engineering techniques gives it permanence. No matter how well a dam is constructed, sedimentation eventually will fill the reservoir it creates, unless we reduce the silt inflow. The useful life of reservoirs can be greatly extended by suitable preventive measures that are taken in time.

The people using watershed lands and the various local, State, and Federal agencies which are concerned with conservation and land management already are doing much of the needed work. However, increased attention must be given to the special problems of protecting the enormous public investment in Reclamation works and in protecting the millions of acres of irrigated land that are dependent for their water supply on Bureau reservoirs.

Reforestation of mountainsides, revegetation of grazing lands, and the use of farming practices which prevent the soil on millions of good acres from wasting into the rivers are some of the practices which are used.

A broad-gage program, focusing these practices on the needs of Reclamation projects, was mapped out in November at a conference in Washington, D. C., of the Operation and Maintenance supervisors. The session on conservation policy and program was held jointly with representatives of the Branch of Project Planning. The proposed program is now being reviewed in the field by the Regional Directors prior to its adoption by Commissioner Michael W. Straus. The plan which the conference worked out will be tied into the Interior Department program through the Office of Land Management.

The call to action was stated by Acting Commissioner Kenneth Markwell. He pointed out enormous demands which have been made upon this country for food and raw materials of almost every variety by the recuperating nations of Europe. Secretary J. A. Krug has set in motion in nearly every bureau and office of the Interior Department an intensive study of means to increase and conserve our national resources to meet the demands of peace—and, if need be, the requirements of national defense. Edward N. Kavanagh in the Office of Land Management is coordinating the conservation programs of the various Interior Department agencies. The Bureau of Reclamation is cooperating fully with this program.

Assistant Commissioner Wesley N. Nelson opened the session on conservation by reading excerpts from a speech made by Robert S. Kerr, former Governor of Oklahoma. He read:

"Most of history's wars have been fought to keep or obtain natural resources, including the chemical elements that give fertility to the soil. Yet, in whatever direction we look we see the results of waste, erosion, and useless destruction.

"On the face of our denuded forests, our scarred and eroded acres, our polluted and silted streams, many of our oil and gas fields from which only the cream of production was skimmed and which were too soon abandoned, the hand of destiny has written the condemnation of the extravagance of this and past generations: 'Thou hast been weighed in the balances and found wanting.'

"Shall we maintain a fierce and stubborn pride in the face of this condemnation, or shall we acknowledge our responsibility and obligation and honor them?"

The conference report is a direct answer to that challenge. The group recommended to the Commissioner that a program be adopted effectively to apply all of the funds that are made available for conservation purposes. A program of $50,000

(Continued on page 16)

Above, spraying to outlaw mysterious disfiguring thrip disease. Below, thrip-infected grapefruit. Top photo by Harry W. Myers, by Ed Handly, Region III, Boulder City, Nev.

The *BITTER* and SWEET of Citrus Farming

by **Harry W. Myers,** *Regional Photographer, Region III, Boulder City, Nev.*

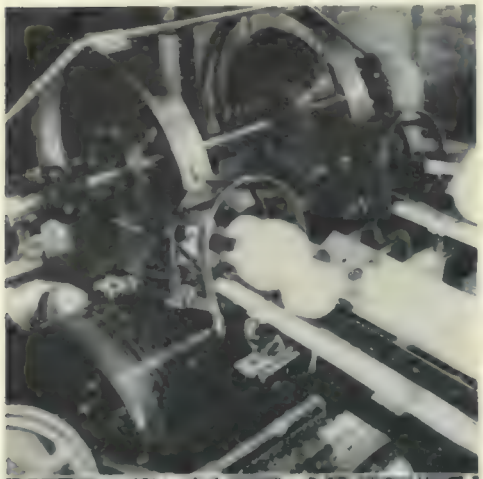
Would you like to make a fortune? Here is your opportunity. The citrus growers are looking for someone to solve a problem they have been battling for years. It means millions to the growers and better living for everyone. It means stabilization for the industry. And it means money in your pockets, if you are the bright person with the right ideas.

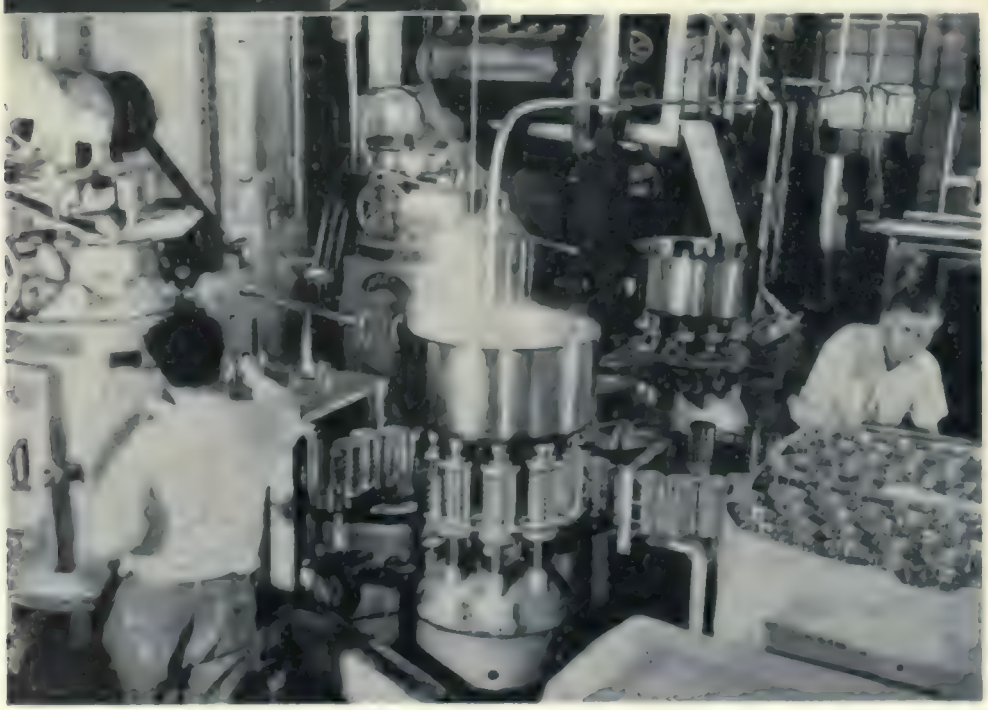
The problem may be stated simply—how can fruit, which can't be marketed fresh, be disposed of profitably? There has always been a surplus of usable fruit which cannot be sold. For years this fruit was dumped to rot, while the growers tried many ideas to turn this waste into a profit. Unsuccessful attempts were made to develop salable wines and brandies and to produce other byproducts. Early efforts to can citrus juice failed. The juice spoiled in the can. This problem was eventually solved by pasteurizing the juice prior to canning. And although pasteurization kept the juices from spoiling and did not alter the food value, it did, unfortunately, change the taste. That "fresh fruit" taste just wasn't there.

Despite this, the industry plunged into canning and the juices sold readily for a few years, but now warehouses are filling with cases of juice. The industry is finding it harder and harder to dispose of its yearly pack.

If only they could can that "fresh fruit" taste, the growers believe the market for juice would increase tremendously. Quick-

Perfect the following operations to enable the grapefruit to retain its fresh fruit flavor and sweeten your bank account. Step 1, cutting and slicing fruit; Step 2, pasteurizing juice; Step 3, canning and sealing. Somewhere along the line the fruit loses its original flavor—but where? Photos by Harry W. Myers and Samuel B. Watkins, Region III.





freezing may provide a solution. It is being tried, but not on a large scale as yet. Possibly the answer lies in a new method of packing and distribution that will cut consumer costs and provide a bigger market. Or, perhaps citrus fruit is the base for some valuable byproduct.

At any rate, citrus farmers are keeping their eyes peeled for a solution to the canning problem as well as other perplexities connected with their industry. They are busily engaged in a never-ending search for the best ways to plant, care for, and market their fruit.

Take for example the Yuma Auxiliary project near Yuma, Ariz. This is a comparatively small citrus-producing area but the farmers who till its soil have lots of "know-how." Last year on 1,727 acres they produced a crop worth almost $605,000. This figures about $350 to the acre.

The first citrus trees were planted on the auxiliary project in 1909. The area then was known as "Yuma Heights" since it is located on the mesa overlooking the city of Yuma. About this same time the Bureau of Reclamation was developing the Yuma project. The mesa grove, a private development, pumped its water supply from wells and continued in production until the 1930's when rock-bottom prices and rising operation costs forced its abandonment.

In 1914, three men—Mr. Hill, Mr. Wood and Mr. Vincent—started an extensive citrus development further south on the Mesa. Using pumped water, groves were planted and brought to maturity. The project slowly bogged down under high development and operation costs, and never attracted sufficient growers to be a paying proposition. Today, of all these groves, only the Hill Orchard is still in existence.

The present flourishing citrus industry on the Yuma Mesa had its beginning in the Bureau's studies made in 1917, 1918,

The barren waste above, now being staked ou laborers planting Valencia oranges, and at Right, giving the trees a sunburn treatm to stimulate growth of trees. Photos by Ha

and 1919. From these studies, it was determined that an area further south and slightly west of the original private developments was ideally suited for large-scale citrus growing. There was little rainfall, the relative humidity was low, the area was free of injurious plant pests and damaging frosts—an extremely rare set of circumstances.

In 1919, 6,300 acres were offered for sale at public auction. Funds derived from this sale were sufficient to enable the Secretary of the Interior to authorize the construction of works to irrigate 3,800 acres with the water to be pumped from the Yuma project's East Main Canal. The first water was delivered to the system in 1922; and by 1923 there were 300 acres planted to citrus.

From this small beginning, despite low prices and depressions, the project has grown and prospered. At the end of 1946 there were 1,727 acres planted and 400 additional acres readied for planting. Of this acreage, 1,033 acres are in grapefruit, 390 acres in oranges, 282 acres in lemons, 20 acres in limes and 2 acres in tangerines.

In spite of lower prices and the threat of surplus production, new acreage is still being planted—although no longer to grapefruit. Some grapefruit growers are even considering cutting back and budding their trees to oranges—a process which takes the trees out of production for 3 years. There has been very little budding-over in the Yuma Mesa groves to date. It is being done much more extensively in the Salt River Valley where operating costs are higher.

Thick skin and rough skin texture of fruit have plagued Yuma Mesa grapefruit growers but careful attention to exacting nitrogen requirements has done much to overcome this difficulty. The same March Seedless grapefruit grown in the Salt River

ne day be a beautiful orange grove. Center e checking to make certain trees are alined. e leaves on ground which have been stripped , Region III

Valley and in the Coachella Valley, especially in the case of the latter, have much smoother and thinner skins.

Yuma Mesa growers insist that their grapefruit is far superior in flavor regardless of skin texture. As to flavor, that seems to be a very controversial question, judging from the claims of the various areas. But it can be safely said that skin texture does not impair fruit quality. However, because the public has come to accept skin characteristics as criteria of quality, Yuma Mesa grapefruit has often brought as much as a dollar less per box in the competitive market.

The planting of a new grove begins with the leveling of the land on a grade that will permit proper irrigation. Following the leveling, a cover crop (usually alfalfa) is planted to prepare the soil and to hold it in place during the wind storms. The cover crop is left in usually until the trees come into bearing. During the past years of high alfalfa prices, growers with new orchards have defrayed part of the cost of bringing a grove into production by cutting and selling their alfalfa.

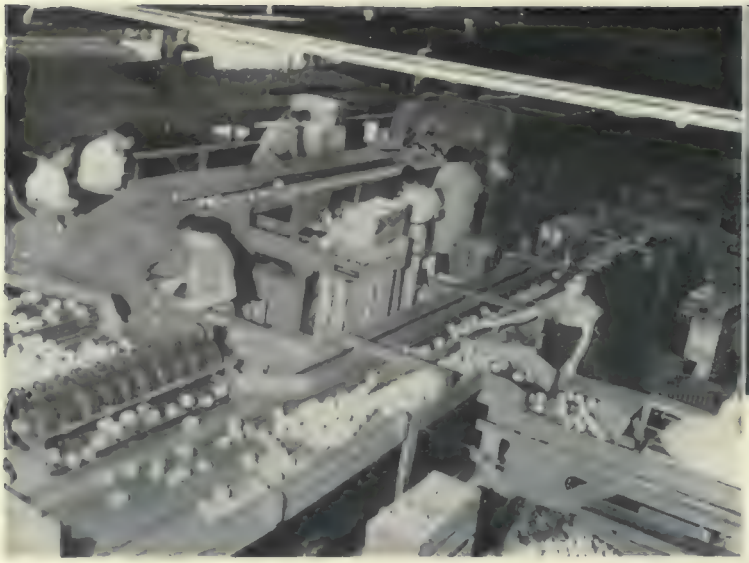
Two-year-old rough lemon stock, budded over to the variety of citrus desired, commonly has been used for new groves on the Mesa. Extensive tests are underway to determine the possibilities of other stocks. At the time of planting, the bottom of each hole is lined with a shovel full of barnyard manure. As soon as new trees are in the ground they are usually stripped of all leaves. Thus treated they recover from the shock of transplanting and regrowth starts more quickly. Following the leaf stripping, each tree is white-washed to protect it from sunburn.

The first year after planting is the critical period. Young trees require a great deal of water and are irrigated every seven to ten days, depending on climatic conditions.

Above, mechanical loader, brain-child of Harry Ellis, Yuma Fruit Growers Association, which saves precious time in getting fruit on its way. Right, petite packer Dorothy Tschilar of Phoenix, one of the fastest in the business. Photos by Harry W. Myers, Region III.

Old groves require water every 14 days. Five years will pass before a new grove produces sufficient fruit to pay maintenance costs.

Citrus thrip is the only plant insect pest with which the growers on the Yuma Mesa have had to contend. Thrip cause damage by feeding on the skin of the tiny new fruit as it forms from the blossom. To combat the thrip, a mixture of 1 pound of tartar emetic and 6 pounds of sugar to 100 gallons of water is sprayed on the trees during the blossom season. The sugar attracts the



Left, interior of new packing plant at Yuma. In center foreground is sorting table and left, roller stamping machine which trade-marks fruit. Above photo shows exterior of packing shed with conveyor belt handy to trucks, left bodyside of which is unhinged, creating shoot direct to belt. Photos by Harry W. Myers and Samuel B. Watkins, Region III.

thrip and the tartar emetic kills them. While this spray does not kill off all the thrip, it does reduce their number to a point where the damage is not serious.

A few of the growers have used DDT as a spray, but to date it has not come into general use. Other methods of control are being investigated. The damaging "scale" that has played havoc with California fruit, has not invaded the groves on the Mesa.

Killing frosts on the Mesa occur so seldom that none of the growers equip their groves with smudge pots.

The trees blossom in the spring, usually in March. Often, especially if prices are low, some fruit from the last crop is left hanging on the trees amid the blossoms, and fruit harvest continues until early summer. Throughout the hot summer months, the new fruit grows and matures.

Picking begins in October and continues until the trees are stripped of fruit. Fruit that cannot be sold is either juiced or dumped on the desert to rot. Yuma Mesa growers use crews of 12 to 15 men, each with a foreman, to do the picking. Each crew works as a unit rather than as individuals. A crew will pick from 24 to 40 tons of grapefruit a day. Pay is on a tonnage basis. The total tonnage picked per day is less when picking oranges. Pay per ton last year was $2.90 for grapefruit and $4 for oranges. Average pay for a picker is $50 to $60 per week.

Each crew works with two trucks and while the first loaded truck is driven to the packing shed (a round trip of 25 miles), the crews load the second truck. The Yuma Mesa Fruit Growers Association has abandoned the use of field boxes for bulk handling of fruit. In the orchard the fruit is loaded into high-sided trucks with a mechanical loader. These trucks are dumped at the packing shed onto a slatted conveyor which carries the fruit into the plant. This method has eliminated a great deal of hard hand labor, speeded up the processing of the fruit and reduced handling costs.

This continuous conveyor takes the fruit over the presizer, where all over-size and under-size fruit is removed. In the case of oranges, this fruit is sold in bulk as culls—usually to juice plants. The conveyor system carries the fruit rapidly over rotating transverse dry brushes which thoroughly clean each one.

From the cleaner they pass into the waxing machine to be waxed and polished, then over the grading table, where the graders remove scarred and misshapen fruit.

Leaving the grading table, the fruit is channeled over inked rollers where the brand name is "rolled" onto each orange or grapefruit. A roller system distributes the fruit, deftly sorting it into standard sizes, to the long packing tables.

Girl packers, with a dexterity that is fascinating to watch, wrap and hand pack the fruit in boxes. As the left hand reaches for a paper, the right hand picks up the fruit, there is the flash of a quick twist, and the wrapped fruit is in the box. The packers are paid on a piecework basis, depending on the size of fruit and type of pack. The scale per box varies from 3½ to 18 cents.

Top packers, depending upon the fruit and type of pack, will pack from 100 boxes of wrapped oranges to 390 boxes of unwrapped grapefruit a day. Originally most of the fruit was wrapped before packing. The necessity for cutting costs and wartime shortage of paper, forced the development of other packs, such as the "place pack" (all fruit unwrapped) and the "blind pack" (two rows in the bottom and top layer, wrapped).

The various size packs are sorted out and trucked into refrigerator cars for shipment. These cars are iced only during the warm fall or spring months. Most of the grapefruit packed in Yuma is shipped to western markets.

The whole industry—from grower through packer—is working to cut costs, to find new, cheaper methods of delivering the fruit to the consumer.

A large part of the final cost of citrus to the consumer is the packing cost. There have been some attempts to sell bulk fruit, but so far no convenient, cheap method has been evolved to transport large quantities of bulk fruit over long distances. Some of the growers, particularly those in southern California who have higher operation costs, are experimenting with fruit sacked in various size string sacks, in an attempt to cut costs. It is possible that, except for the luxury trade, the familiar case of wrapped fruit we see today with its high packing costs, may be on the way out.

The Yuma Mesa Grower's packing shed is a modern concrete building, equipped with the latest in citrus fruit processing machinery. Its old shed burned in 1944, and while this was definitely a blow at the time, it did enable the association to build its present, airy, efficient plant. While the plant is geared primarily to the packing of grapefruit, it can be converted over in 30 to 40 minutes to packing oranges.

Yes, the citrus industry has its problems, but despite all these, most of the Yuma Mesa growers are satisfied with their investment as evidenced by the constant inquiry for land suitable for citrus production. •

Survey Forecasts Cropland Crisis

The findings of a recent Associated Press survey disclosed the following:

Crossing of the rising population line and declining cropland line about 1950 with gradual deterioration of the American standard of living as an inevitable corollary is forecast in a recent Associated Press survey of statistics of the Bureau of the Census, Soil Conservation Service, and Bureau of Agricultural Economics.

Total good cropland left in the United States is set at 460 million acres, comprising 390 million acres of lands immediately available, and 70 million acres requiring reclamation by irrigation, drainage, or other improvement work.

The population estimates indicate 147,500,000 persons by 1950, rising to 165 million by 1990. After 1950 there will be fewer than the traditional 3 acres per person for the first time in history.

How to Conserve Irrigation Water Supplies (Part One)

By L. R. Fiock

SUPERINTENDENT, RIO GRANDE PROJECT, N. MEX.-TEXAS, REGION V

Editor's Note:

When extreme droughts in the Rio Grande watershed threatened the Bureau's 155,000-acre Rio Grande project in New Mexico and Texas, the superintendent and officials of the El Paso and Elephant Butte irrigation districts initiated a comprehensive educational campaign on water use and enlisted the support of all farmers to conserve the dwindling irrigation supply. Water users rallied to meet the challenge. They participated as a group in a program to utilize the natural resource for peak per-acre production, and the project-wide enterprise was eminently successful. In the following article, Superintendent L. R. Fiock, discusses conservative use of an irrigation water supply.

Although his statements apply particularly to the Southwest and specifically to the Rio Grande project, many irrigation farmers in other sections of the West may find helpful suggestions for conserving water in their area.

Photo by Ben D. Glaha, Region II

ROW-CROP IRRIGATION. ***The little wooden tubes through which the water is led from the farm header ditch into the furrows are called spiles. The mouth of the tube extends into the header ditch several inches and the flow is regulated by driving a lath vertically against it, and moving the lath sideways to open or close.***

When is an irrigation project feasible? How large an area should be included in the project? The answer to these questions depends upon the available water supply—not the amount of land that is irrigable, nor topographic obstacles that present construction difficulties—but available water supply, first, last, and always. This is true in the semiarid West, particularly in the arid Southwest.

Major steps required to achieve maximum use of the water supply for ultimate crop production are outlined briefly as follows:

- Storage and release to meet irrigation requirements.
- Diversion of storage release or natural stream flow.
- Operation of the distribution system.
- Delivery of water to farms.
- Preparation of land for irrigation.
- Use of water on land to produce crops.

True conservation in the use of the water supply should result in production of the greatest quantity and quality of crops attainable by the most efficient use of the amount of available water. Beginning with control and regulation, the end objective—water on the land to produce crops—must be kept in mind at all times.

STORAGE AND RELEASE TO MEET IRRIGATION REQUIREMENTS

It is reasonable to expect that the most conservative use can be made of the water supply where it is controlled by storage located within a reasonable distance of the point of use. Releases can then be regulated to meet requirements with minimum waste or deficiency. However, deliveries must be based on orders received sufficiently far in advance to allow the releases to arrive at each point of use when needed.

This requires constant vigilance and alertness and cooperation between the farmers and the operating organization.

FARMERS must know their soil, moisture, and crop conditions in order to anticipate advance water requirements.

DITCHRIDERS must get their orders in advance of actual need and turn in their requests to the watermasters.

THE WATERMASTER must inform the project water dispatcher of the total amount of water requested by ditchriders in his division.

THE PROJECT WATER DISPATCHER then must total the requests of all divisions. He must also allow for river losses and gains in transportation, drain return flows and probable operating waste available for rediversion. He then determines the amount to be released from storage and directs the gatetender to regulate the outlet gates accordingly.

The most beneficial and economic use of a water supply generally contemplates occasional years of shortage as well as some years of overabundance. This is especially important where irrigation is limited by an available water supply rather than by land susceptible of irrigation. In the arid Southwest the supply is limited and the watershed run-off, which is the source of supply, is extremely erratic from year to year, varying annually between 10 to 15 times the minimum. Under such conditions, it is necessary to have reservoirs with large carry-over capacities.

The basis for development and operation of the Rio Grande project in New Mexico and Texas is the control by storage of the very erratic run-off of the Rio Grande, which varies from 200,000 to 2,800,000 acre-feet annually.

The capacity of project storage reservoirs is sufficient to control almost the entire run-off of the Rio Grande entering the reservoirs and the carry-over of water from years of abundant run-off for use in years of deficient run-off.

The capacity of Elephant Butte Reservoir is 2,200,000 acre-feet at spillway elevation; Caballo Reservoir has 346,000 acre-feet capacity; a total of 2,546,000 acre-feet. In 33 seasons of operation, overflow spill has occurred in only 1 year, 1942, or 27 years after the commencement of storage operation in 1915—1 year before completion of Elephant Butte Dam.

Although there has never been an actual shortage, the project has been threatened at the beginning of 4 years, 1919, 1935, 1941, and perhaps 1948.

This record might be taken to demonstrate a fine balance between the water supply and irrigation use, but it must be recalled that at the time storage water was first available in 1915 there were only about 70,000 acres in cultivation.

The area in cultivation has gradually increased until the project development now approximates 100 percent with 155,000 acres irrigated—the area for which there has been considered to be a safe and reliable water supply. As the irrigated area increased, the more necessary it became to control and conserve the water.

There now is apparently no way to increase the water supply. A change in crop system, that will result in a material decrease in acreage planted to cotton, with a corresponding increase in the acreage of other crops, is inevitable on the Rio Grande project. This change may require the delivery of water on an allotment basis as a normal practice each year.

It has been determined that the average amount of water available for release from storage is 790,000 acre-feet annually. Although this amount is mentioned in the Rio Grande Compact, it is not an arbitrary amount fixed by the Compact. It was fixed by the Compact Engineers in their study of past records and substantially agrees with findings stated in the reports on several previous studies of the project water supply. With 790,000 acre-feet the average annual amount of water available for release from project storage, farmers must expect that each year water is released in excess of 790,000 acre-feet there must be that much less water released in other years to compensate for the amount taken from storage.

Aside from any disadvantages or penalties devolving upon the project through the operation of the Compact for having exceeded an average annual release of 790,000 acre-feet (and the Compact does inflict such penalties) if excess releases are not compensated for by under releases, the inevitable result will be to intensify shortages when they do occur, both as to frequency of occurrences and acuteness.

Such would be the consequences during low reservoir stages, which are sure to occur, if wasteful water practices are followed during periods of high reservoir stages. Conservation is the watchword.

Diversion of Storage Release or Natural Stream Flow

Whether diversions are from storage release or natural stream flow, available water should be allotted to the various divisions or districts in accordance with requirements, previous orders, or priority of water right. Deficiencies should be prorated accordingly. Diversions should be measured and reported daily.

When increased demand develops, waste ceases, and if a lower division has been depending on waste water, that division suddenly finds itself doubly short of water, for it also probably has increased its demand.

Each district, division, unit, and farm on an irrigation project must be held responsible for its proportionate share of waste reaching the lower end of the project. Lower units cannot and should not be expected to depend on or have to absorb the waste from other units.

Operation of the Distribution System

The distribution system can be operated most efficiently in the Southwest where there is little precipitation during the growing season by grouping deliveries to farms. This may be referred to as the "rotation plan" but, when combined with an order system, it becomes a modified rotation-order system.

This provides for deliveries to be made in accordance with orders received but varying sufficiently from the sequence in which they were received to insure that deliveries move up the canal or lateral in the same general area.

It gives the ditchrider better control over the water and makes it possible for him to give better service by eliminating the need for him to travel continuously back and forth over his unit. This plan also reduces waste because it is not necessary to handle small heads in laterals over the entire unit.

Each ditchrider should request the amount of water required for his particular unit on the basis of orders received. Then he should account for the total in the delivery charges, less a reasonable allowance for system losses and possibly, where permissible, a minimum of unavoidable operating waste. However, this waste should also be reported. When deficiencies occur, the immediately available supply should be prorated over the various units in proportion to the requirements of each.

Ditchriders should report daily by telephone to their division watermaster, giving the amount of water being received, the total number of acres for which there are outstanding orders, and general conditions of each unit. Watermasters should then make a summarized daily report to the project water dispatcher.

Running extra water through one unit and counting on the unit below to make use of the waste cannot be tolerated in a good operation. The lower unit cannot operate on waste from above. The only reason for running extra water through a unit should be to have it available on demand or in case of an unexpected increasing demand.

Delivery of Water to Farms

The manner of making deliveries to farms may vary considerably in accordance with established practices and customs, but it is influenced largely by the character of the water supply.

There may be variations and modifications by partial combinations of methods but all are subject to restriction by allotment or rationing in times of deficiency. Here is a description of some of the methods in use.

Continuous Flow usually involves the use of small heads continuously rotated over the farm. This is not generally the most efficient as it results in great loss and may also cause the farmer to use water when not necessary.

Strict Rotation means the delivery of a fixed head of water for a set period at regular or established intervals. This too, may result in the use of water when not really needed and, to that extent, is a wasteful practice.

Delivery on Advance Orders is made to meet anticipated actual requirements, modified by sufficient rotation to keep deliveries bunched. This appears to be the most conservative and efficient practice, especially where the water supply is controlled by storage and releases can be regulated when and as needed to meet requirements.

Delivery on Demand, at least in the Southwest, is the most wasteful practice of all and cannot be utilized when the demand exceeds the capacity of the irrigation system or where there is a deficiency in the supply.

Equitable distribution of the available water supply; uniformity of service to all users; efficient and conservative control in distribution; and necessary records as a basis for the accomplishment of the above can only be achieved by the application and use of reliable methods for measuring individual deliveries to farms, diversions and distribution to lateral canals. This becomes increasingly important when the supply is limited and rationing or delivery by allotment is necessary.

On an irrigation project, as in any utility service, flat rates breed wasteful practices. Flat rate charges usually should not be tolerated. Possible exceptions are limited to communities of small home sites, where a relatively small percent of the area not covered by improvements is irrigated, and the amount of water used cannot justify the extra cost of making accurate measurements, charges and billings for each irrigation.

In some cases a graduated rate schedule, with increasing rather than decreasing rates in proportion to the amount of water used, encourages conservative use.

(To Be Concluded In Next Issue)

FM RADIO Works for RECLAMATION

Photo by Harold Foss, Region I

Photo by Frank B. Pomeroy, Region I

Above, central unit of the short wave radio set is operated at Columbia Basin project headquarters by E. B. Comstock, Right, Project Superintendent Phil C. Royer on his tour of the Potholes Dam job calls for emergency aid to start idle dragline, in background.

by Gene Nicolai

Columbia Basin Project, Region I

Moving as silently as the shimmering heat waves of eastern Washington's summers, radio signals flash along the 3½-mile Potholes Dam of the Bureau of Reclamation's Columbia Basin irrigation project to coordinate the countless activities that go into building the Nation's fourth longest earth-fill barrier.

Patterned after communications systems that function so effectively for police and highway departments and other organizations, the Potholes Dam radio network is writing a new page in the use of static-free frequency-modulated equipment. With it, the contractors have eliminated all guesswork in sending and receiving messages along a far-flung construction site. Today each part of the job is in immediate touch with the other and with headquarters.

As one engineer described it: "F-M radio is the answer to a contractor's prayer for efficient communication."

Builders of the Potholes Dam (Lytle, Amis, and Green) have six combination sending and receiving sets in the field and one at headquarters, which is atop a hill overlooking part of the great dam. The headquarters station also is connected with a companion unit at the main repair shop. Five of the six field sets are installed permanently in cars and trucks. A sixth set is portable and can be used in any vehicle or location when needed.

Because it covers a limited area, the network has only one licensed operator. He is responsible for Station KWDH, the headquarters unit, and for the field units. The field sets, using the call letters KWDI, followed by identifying numbers, can be operated by any authorized employee.

Transmission of vital messages is instantaneous. If a workman is injured on the job, headquarters is notified at once by a field radio, and an ambulance is dispatched immediately to the scene of the accident. If a power shovel or other equipment needs service, the shovel mechanic's truck or the field mechanic's truck is notified by radio, regardless of where the repair equipment may be.

On an average day, the high-frequency network may carry 40 or 50 messages. On a particularly busy day, the number has reached 70.

KWDH, being in the headquarters building, is the busiest unit and is handled by E. B. Comstock. Standing beside his desk, you can take in a series of typical messages to the KWDI units in the field.

Here's one:

"KWDH calling KWDI–One."

"KWDI–One. Royer."

"We have an important message for the survey crew. Have you seen them lately?"

"Yes. I just now passed them up near Station 29."

"Can you drop back to them?"

"Sure. What do you want?"

"Have the chief of the party call me on your radio."

"Will do."

"OK. KWDH out to KWDI–One."

Whereupon Royer (Project Superintendent Phil C. Royer) who has KWDI–One radio set in his car, is cutting through the sagebrush to reach the surveyors. In a few minutes, KWDI–One, with a member of the survey crew speaking, contacts headquarters and receives new orders.

As Royer travels along the job, his radio is picking up other messages being sent from headquarters or being received there from other radio units.

Telegrams from all parts of the United States are relayed immediately to the field. Requests for parts are transmitted in a matter of seconds. Orders are passed along to key men on the entire job in less time than it takes a man to walk across a room.

"You might describe it as being like a seven-party telephone line, with each telephone owner listening in and talking when occasion demands," says Comstock. "Is it worth it? Just ask anyone on the job. There's no fumbling of the ball when you have two-way radio; no delay." ●

COMING NEXT MONTH

River Control by Radio by Rolland F. Kaser, of the Office of River Control, Region III.

Organization for Progress

by ALFRED R. GOLZE, *Acting Director, Office of Programs and Finance*

The Office of Programs and Finance was recently created in the Bureau of Reclamation to streamline its administrative structure by putting together under one head the fiscal, budgetary, and programming work previously divided between three separate offices.

The coordination and integration of these various functions is one of the two main objectives of the reorganization. Control of expenditures and allotment of funds as directed by the Conference Report on the 1948 Appropriation Act, is the other. The combined aim of the new organization is the fullest, most economical use of all available funds for the maximum construction effort.

You, as a water user, get the benefits of reclamation, and as one of the underwriters of the repayment obligation you also help foot the bill. You want to know what you are paying for. You want to know that the work has been done—or will be done—rapidly and economically without costly delays or needlessly added expenses of other kinds arising from poor coordination and unrealistic planning.

Budgeting and programming go hand-in-hand, each meshed with the other. For each authorized project and potential project in each river basin still under investigation, a long-range program is developed. A consolidation of these long-range programs, projecting the work into the future and providing an integrated plan for periods of many years, serves as a base for the preparation of annual budget estimates submitted to Congress by the President. To insure a higher degree of correlation and interlocking year-around functioning, the programming and budgeting have been combined in the new office. In the preparation of the 1949 estimates of appropriations the budget has been geared exactly to a predetermined program.

When the budget process has been completed and the Congress has determined the amount of appropriations for a fiscal year, the program group supervises and coordinates the translation of these appropriations into definite work schedules designed to utilize the available funds with maximum effectiveness.

The need for adequate controls and detailed reporting of work progress and fund expenditures in a program of such vastly increased scope, places a heavy responsibility on the new office. With Reclamation activities spread widely over 17 States and under the direction of 7 regions, numerous districts, and projects, the Commissioner and his immediate assistants cannot maintain close personal supervision of individual operations. In the main he and his regional directors must rely on carefully evaluated, selective, and comprehensive reports and digests to maintain close control of this far-flung organization.

The rate of progress of the whole program in all of its complex aspects is anticipated by the "flag dates" (dates set for the completion of specific jobs) in the work schedules formulated at the beginning of the fiscal year. Subsequent reports recurrently count the pulse of the program, enabling the administrators of the Reclamation program to spot places where the work is lagging and take steps promptly to get it back on schedule.

Your Bureau of Reclamation—operating very much in a fishbowl under a policy of full disclosure—must make many varied and special reports to your elected representatives in the Congress and to agencies of the executive and administrative branches of the Federal Government. To make these reports promptly and accurately requires an up-to-date reservoir of extensive data additional to the information required for administration of the program.

The Bureau of Reclamation regularly reports to the Congress, the General Accounting Office, the Bureau of the Budget, the Treasury, the Federal Power Commission, and the Secretary of the Interior—all of whom have regulations or rules which must be observed.

A newly instituted quarterly report to the House and Senate Appropriations Committees for example, details the status of funds, costs and allocations to project features. These various reports, unfolding every phase of the Reclamation program and exposing every recess to public scrutiny, insure that it is administered strictly in accordance with the will of the Congress.

Accurate cost accounting—the third major function of the Office of Programs and Finance—has been of primary importance in Reclamation since work began in 1902, because of the repayment provision of the basic law. Every water user has to pay a share of the recoverable construction cost, making it vitally important to you that the costs are fairly determined and equitably allocated.

The accounting system reflects the widening experience of Reclamation under changing conditions for nearly half a century. Now, responsive to the demands of the rapidly accelerating construction tempo of the program, the time-tested system is being further reshaped to provide the highest possible degree of flexibility consistent with sound accounting practice. •

Report on Conservation Conference

(*Continued from page 8*)

to $100,000 for the purpose is proposed for conservation activities in each Reclamation region for the fiscal year 1949.

With these funds, action programs would be started in each region designed primarily to prevent erosion in the drainage basins from which Reclamation projects derive their water. These will be started on lands under Interior Department jurisdiction wherever the initial expenditure of limited amounts of money can be expected to produce results. At the same time examinations will be started to find the most fruitful fields for larger scale activity. A preliminary inventory of such undertakings will soon be available largely through utilization of surveys and reports already made by the various conservation agencies.

Specifically, the conference suggested that the rseponsibilities of the Bureau of Reclamation in the conservation program be defined as follows:

- To determine the waste, loss and damage that has occurred or may be anticipated to occur on Bureau projects.
- To inventory the general areas of watershed lands which are the source of harmful silt or flood flows, or from which soil and water is being wasted.
- Where such source areas are on Bureau-controlled lands, to plan and carry to completion programs for the control of soil and water losses.

It was particularly recommended that where private, local, State, or other Federal agencies are carrying on adequate programs designed to meet the Bureau's objectives, the Bureau coordinates its activities with such programs. Other agencies which are concerned with the broad program are the Office of Land Utilization, Bureau of Land Management, Geological Survey, Bureau of Indian Affairs, and Park Service in the Department of the Interior: the Forest Service, Bureau of Plant Industry, Soils and Agricultural Engineering, Soil Conservation Service, the Office of the Secretary charged with flood control program of the Department of Agriculture: the Army's Corps of Engineers, State Highway Departments, and State Departments of Agriculture.

(*Continued on page 18*)

Growing Up With the Country

"He is growing up with a country that grows with the vision and effort of men like himself." ***Jay Carman, new homesteader on the Roza Division of the Yakima project.***

Written for the ERA by Elma Hill Neal

Photographs by Stanley Rasmussen

Everywhere out here in the West we hear the phrase, "growing up with the country."

Over in the Magic Valley, a rugged old Twin Falls pioneer will tell you that he has been there more than 40 years and "grew up with the country." Young veterans and their wives are taking up homesteads on the Minidoka project or in the Yakima-Roza area, primarily of course to make a better living, but they will explain, with a wistful look in their eyes, that one of their long-cherished ideals is to get out on some new land and "grow up with the country." It's a fine phrase and it has more meaning than at first meets the eye or the ear.

When one thinks back, he knows that for many geologic centuries the country has grown up. Vast glaciers have swept down from the North and took aeons to melt and vanish, leaving only their great swooping marks along the terrain. Enormous lakes were gouged out and for ages they supported a marine life that died and enriched the soil when the waters finally seeped away. For generations the rivers have run down to the seas, scooping out their courses, tearing at the soil, building up their deltas. For centuries the wind has blasted along the plateaus and shrilled down the valleys. For eternities the rain has beat down and the sun has beamed broadly, the forests have grown great and the plains have tossed their grasses like the waves of the summer sea. And yet, in this twentieth century, man makes the remark that he is "growing up with the country." The country was old when man came to it.

Still, there is an element of rightness in the use of the saying, if for no other reason that, in this calendar year, the balmy charm of an April morning will be as sweet and fresh as when man first tilled the land and the colors in autumn this year will gleam like rubbed gold, and the first snowflake will be as pure and white as those that fell on the Grand Teton a thousand years ago. Each spangled dawn is new and inspiring, each reddening sunset burns with an undimmed glow. Only a wise God could have made a world so old and yet so perpetually new. Lucky man can still grow up with the country.

But "growing up with the country" involves old-time virtues often hidden away in this scientific age, like that peculiar brand of courage that hangs on in the face of monotony, or that sort of good humor that laughs at mistakes, or that type of resourcefulness that gets around a lot of obstacles that cannot be imagined but can only be met up with on a piece of raw ground.

Most of the problems of farmers are discussed in agricultural journals or thrashed out in farm meetings, but the distaff side of the modern pioneering set-up on newly irrigated lands is one to be considered seriously before undertaken, because too little has been said about it that really helps.

On most of the projects, it has been the earnest attempt of the settlers to get habitable places in which to live before bringing their families. Sometimes this is impossible, for getting the crops in the ground is first and foremost in a homesteader's thoughts. Early financial return is a saving grace, yet every woman who is willing to live with her husband on an undeveloped project is anxious to share in the pioneering and usually moves into a house of a sort before it has much more than shingles on the roof. She too, feels the challenge and delights in her own paint job on the wood work. She glories in the rose-bedecked paper that she pasted on the walls of the bedroom herself, and in the smell of clean kalsomine in the kitchen. She helps her husband put up the cupboards at night while her city sister is taking in the premiere of a new show. There are no baby sitters on new projects unless the hired man can be occasionally coaxed to take the part.

But there **are** babies, and they play their part in the pioneering. Young Junior sleeps placidly in an apple box in the spring sun while his mother hills up long rows for lettuce and string beans, or sets out strawberry plants. He gurgles contentedly while his parents plant pencil-size Chinese Elms and Early Transparent Apple trees. His older brother delights in the vastness of space in which to roam and to dig, the joy of little chickens and young calves and of a dog at his heels. Nowhere else does a child more quickly learn the privilege of early responsibilities.

It is very true that the woman pioneer

Home is what you make it. Left, Junior Hall on the Roza project gets a "once over lightly." Center, the Burns of Roza, with their electric stove, are almost "luxury liner pioneers." Right, Byron Myers "supervises" the missus' artwork.

today can take with her a radio and a washing machine. She can listen to the morning news, **provided** the battery hasn't run down or if the electric line has reached their acres. Otherwise the silence is as great as that which surrounded Rebecca Boone in her wilderness home in Kentucky, and the washboard is just as backbreaking as that of Grandma's, who did her washing under a walnut tree on the sandy shores of a Missouri creek. **Provided,** of course, that she has the water. And she does have, if the well works all right. Otherwise she dips it out of the ditch, **provided** the ditches have been dug and the water is in them.

Usually during the first year, with the clothes all gleaming white on the lines which her busy husband found time to put up (or perchance she put them up herself) there is another obstacle to a perfect washday—the dust, oh, my friend, the dust! How it comes rolling in across the freshplowed acres of the Jones brothers to the southwest. It starts up like the Biblical cloud, the size of a man's hand. It raises behind the tractor busy preparing the potato field. It puffs and spreads and seemingly gathers all of the loose ground on the tract. It towers up, brown and menacing toward the zenith and then descends with a rolling fury that leaves the poor clothes wrenched and streaked with ropes of dirt, the window ledges soft with the fine silt and the dishes in the cupboard gritty. No window has ever yet been invented that will keep out the dust from that sort of a storm. She has to laugh that one off, too.

Pioneer women of the West fight the battle of bleakness and bareness and oft-times loneliness. A great naked plain may stretch around them for miles, with mountains seen dimly in the hazy distance. No friendly tree hovers near to beat off the summer sun or lend a feeling of protection or give rest and nest to a singing bird.

But there is always compensation in the soil. Vegetables grow with a Jack-and-the Beanstalk speed. One doesn't exactly have to step back when seeds are dropped into the ground, but with a tiny stream of water to slake their thirst, asters and zinnias and petunias and a world of other flowers soon brighten the doorsteps and the garden edges with their color and perfume. During the long purple twilights and the quiet early mornings, the little gardens are beautiful and green, and appreciation grows for the simple things of nature.

Far to the north and west, the big dam is pouring millions of gallons of water into the huge canals, that in turn pour into smaller. The big generators are turning out millions of kilowatt-hours of energy which are converted into power and light for the individual farms. From project manager through ditchrider to farmer, the flow of water is maintained, but not without help too, from the farmer's wife, who keeps her faithful vigil over lesser channels. She helps her husband make spiles in the shade of the house. These are tubes made from laths cut in short lengths, which when inserted in heads of irrigation rows, control the flow of water and prevent the fine dusty soil from washing away. (*See photo on page 13.*) She uses some in her garden, too.

Once around the calendar on a new farm and the worst part is over. The toehold has been clinched. The modern pioneer and his wife have gained a victory over at least a part of the land. The alfalfa fields hold back the dust storms. Even the patch of lawn planted the first year makes a soft place to lay the baby and to shell peas. One has learned what to expect in growth. One has learned to measure many things, like men and miles and a trifle of money. School districts are laid out. A PTA is organized. A Sunday School is started. Dances are held and community life is begun in earnest.

Pioneers are growing up with the country and the old, old country is growing up with the pioneers. ●

DON'T MISS the story of the British War Bride at Bumping Lake—February Reclamation Era.

Report on Conservation Conference

(*Continued from page 16*)

Solutions for a number of other problems also were sought by the Operation and Maintenance Supervisors. One of particular interest to water users related to the problem of drainage. On this subject the report of the conference committee on irrigation operations declared:

"In planning new projects, ample estimates of cost for foreseeable drainage work should be included in the over-all project cost estimates. This does not infer that such drainage facilities should always be constructed at the same time as the irrigation works." Actually, this proposal is now being put into practice in planning a number of the new projects.

"In project operation," the report continues, "more careful attention should be paid to maintenance of, and results being obtained from, existing drains. Discharge readings of flow from major drains should be made semiannually to check on their continuing efficiency. In order to anticipate the need for additional drainage, project operations personnel should also make observations annually or more often if necessary, of ground water levels at various places over the project area. This can often be done by the use of domestic wells until an area becomes threatened with immediate trouble. When trouble is imminent, consultation should be requested with specialists in the office of the Chief Engineer."

The irrigation operations committee also recommended:

"In general, projects should be turned over to the water users for operation and maintenance as soon after the completion of the project development period as the system has become thoroughly stabilized, the repayment contract in final form has been executed, a reserve fund has been accumulated, and State laws have been complied with."

It was recommended also that an aggressive program should be adopted to train

(*Concluded on inside back cover*)

Lake Mead Sedimentation Survey

Assistant Secretary of the Interior William E. Warne recently approved a cooperative Bureau of Reclamation-Geological Survey sedimentation survey and investigation of Lake Mead. The Geological Survey will be responsible for over-all supervision of the work and the preparation of reports.

In earlier discussions, the Geological Survey obtained favorable expressions of interest from specialists in the Navy Department. Their special skills and facilities are to be enlisted in the project.

The agreements call for reexamination of existing horizontal control; rerun, as necessary, of first order level network; hydrographic and river channel surveys; salinity and core sampling; laboratory work; preparation of maps, charts, and reports.

Additional reports to be prepared include underwater photography, echo-sounding, base data on salinity and density currents, and characteristics of sediment deposits.

Field Level Cooperation Lauded

Field level cooperation in such programs as the Gila and Columbia Basin projects' development farms has produced excellent results, O. & M. Director Goodrich Lineweaver declared recently in an appearance before the Bureau of the Budget to support Agriculture's request for an increased appropriation for the cooperative work.

The cooperative arrangement was initiated by the House Appropriations Subcommittee on Agriculture in 1945, leading to development of a comprehensive Columbia Basin program. The State College of Washington, the Bureau of Plant Industry, and the Soil Conservation Service are cooperating with the Bureau of Reclamation in the operation of Columbia Basin development farms although the memorandum of understanding had not been approved by the Agricultural Research Administration of the Department of Agriculture as this issue goes to press.

The University of Arizona, the Bureau of Plant Industry, and the Bureau of Reclamation are cooperating under the fully approved Gila agreement.

Director Lineweaver told Budget examiners that this type of cooperation paves the way to provision of information to future irrigation farmers on Reclamation projects and gives added protection to the Federal investment in irrigation facilities. Under this procedure, he pointed out, there is no duplication by the Bureau of Reclamation of State college or Department of Agriculture functions. It is hoped, he said, that similar arrangements can be made in each Western State.

Gila Land Opening Scheduled

Assistant Secretary of the Interior William E. Warne recently announced the opening to homestead entry of 4,940 acres of public land on the Yuma Mesa Division of the Gila project in southwestern Arizona. The acreage will provide for settlement opportunities on 54 farm units.

Filing Instructions

All applications received prior to 2 p. m., March 29, 1948, will be considered as simultaneously filed. Applications should be filed with the Superintendent, Gila project, Bureau of Reclamation, Yuma, Ariz., either by mail or in person. All unsuccessful applicants for public land farms on the Yuma project may apply for a farm on the Gila project. Commissioner of Reclamation Straus announced that the general regulations under the homestead and reclamation laws which have applied in previous openings would prevail in the Gila opening.

Veterans' Preference

First opportunity for homesteading will be given to veterans of World War II, the War with Germany, the War with Spain, or in the suppression of the insurrection in the Philippines, who make application for land on the Gila project.

A public drawing from the applications of those qualified, which were filed simultaneously, will be held to determine eligibles to enter the farm lands. It is not necessary for an applicant to be present at the drawing in order to obtain a farm. Successful applicants will be notified by the Bureau of the results as soon as possible after the drawing.

Farm units of two types are available on the Gila project. The units of 80 acres or more are suited to general crop production, while those ranging from 40 to 70 acres are considered more suitable for raising specialized crops such as citrus fruits and vegetables. If either type farm is preferred it should be so noted in the proper place on the application blank.

For additional details write to the Superintendent, Gila project, Bureau of Reclamation, Yuma, Ariz.; Regional Director, Bureau of Reclamation, Boulder City, Nev.; or Bureau of Reclamation, Department of the Interior, Washington, D. C.

Middle Rio Grande Report Approved

Secretary of the Interior J. A. Krug recently announced approval of a departmental report sponsored by the Bureau of Reclamation which outlines a proposed program of irrigation and drainage development in the Middle Rio Grande Valley of New Mexico. Also coordinated in the plan are flood and sediment control development measures proposed by the Army Engineers. The report has been sent to the Governors of New Mexico, Colorado, Texas, and their official designees under the Flood Control Act of 1944, and to the Secretary of the Army, for review and comment prior to submitting it to the President and the Congress.

Because of the urgency for submittal of reports to achieve authorization of the critically needed works for irrigation, sedimentation, and flood control, the coordinated plan does not now include hydroelectric power development other than provision for penstocks at the dams to permit future power installations if later investigations indicate that they are practical and economically feasible.

However, Commissioner of Reclamation Michael W. Straus said that study of the hydro-power potentialities will be continued, and a report on this phase will be submitted as soon as the feasibility of power development has been ascertained.

The report recognizes the need for a watershed control program, and the report recommends that programs to accomplish this be enlarged and that a comprehensive watershed program be undertaken by the appropriate Federal agencies at the earliest practicable date.

Major features of the recommended Reclamation plan are as follows:

- Rehabilitate and extend the irrigation and drainage systems of the Middle Rio Grande Conservancy District, including the El Vado Dam and Reservoir.
- Construct Chamita, Chieflo, and Jamez Dams and Reservoirs for flood and sedimentation control.
- Provide levees for local flood protection.
- Channel rectification of the Middle Rio Grande. This includes Hot Springs and Espanola Valley channel improvements and dredging from near the southern boundary of the Middle Rio Grande Conservancy District into the backwater of Elephant Butte Reservoir, and
- The Blue water floodway project.

Congressional Investigation of the West

by Ralph L. Williams

Administrative Assistant to the Regional Director Region VII, Denver, Colo.

When you were reading in your home-town newspaper or hearing over the radio about members of the House Subcommittee on Appropriations for the Department of the Interior who were inspecting projects in the West, you probably little suspected the hard work involved in that 2 months' inspection by the three members who made the trip.

Photo by Ralph L. Williams, Region VII

Construction Engineer H. F. Bahmeier, in charge of the Davis Dam job, gives members of the Congressional Subcommittee on Appropriations a first-hand account of activities. Left to right: Bahmeier, Chairman of the committee; Ben F. Jensen of Iowa, Hon. George Schwabe, Oklahoma, and Hon. Ivor D. Fenton of Pennsylvania.

Congressman Ben F. Jensen of Iowa, chairman of the committee; Congressman Ivor D. Fenton of Pennsylvania; and Congressman George B. Schwabe of Oklahoma worked hard, and I mean hard. I know, I accompanied them throughout the trip. Just keeping up with them is work, staying even with them is rough, and you can never get ahead of them!

Last spring when the committee was in session, some of them (particularly Dr. Fenton of Pennsylvania) decided that never again would they sit upon a committee, hearing requests for appropriations, without first having visited the projects for which the requests were being made. As a consequence, it was agreed that in the fall they would make an inspection tour of the West.

And what a schedule! Every morning at 7:30 a. m., they were in the hotel lobby waiting to go. They wanted to see the projects first-hand, wanted to talk to the people in the project areas, to the engineers on the job, to the truck drivers, the surveyors, and to those who were planning the various jobs. And that's exactly what they did.

We took off from Sioux City, Iowa. Chairman of the committee Ben Jensen and his secretary, Bill DeyErmand, arrived from Exira, Iowa (Bill with his notebook and all). Congressman Fenton came from Chicago (the first time he'd been that far west), and Congressman Schwabe arrived from Tulsa, Okla. Assistant Secretary of the Interior William E. Warne was on hand to accompany the members as far as Billings, Mont.

The first day gave just an inkling of what was scheduled for more than 7 weeks. We were on the road at 8 a. m., had luncheon at noon at Fort Randall; inspected the dam in the afternoon; then drove to the Niobrara River Basin for an inspection as far as Ainsworth, Nebr. There, about 300 citizens of that valley gave the committee members a huge banquet, told of the benefits they thought a fully developed irrigation project would bring, and asked the Congressmen to tell them their thoughts on the subject. It was a grand meeting—and was followed by a 60-mile drive to Valentine, Nebr., where welcome hotel rooms were awaiting us. Next morning, we were up at 6:30, and went through more of the same thing. visitations during the day, another meeting with a local citizens group that evening, then to bed.

I was right in the middle of this procedure from September 15 until the first of November. And those days shown on our itinerary as "no activities planned, left to the discretion of the committee members"—those were the busiest of the lot. It seemed that everyone who saw a schedule and noted "no activities planned" did his best to see that a full day's work was arranged. In fact, before the end of the trip, we wondered what else could happen on a "no activity day."

What did they inspect? Everything. Proposed dam sites, authorized projects, projects in the first stage of construction, projects nearly finished, and completed jobs. Yellowstone, Glacier, Yosemite, and Grand Canyon National Parks. Some committee members visited the Government docks in Seattle; others inspected the fisheries in Astoria, Oreg. Grand Coulee, Shasta, Friant, Hoover Dams, and dozens of Reclamation projects were visited. The committee spent 2 days driving through the Navajo Indian Reservation and hearing of the problems that confront the Indians and the Indian Service. They listened to the Taos Indian tribal council, with its great wisdom, declare that appropriations to them were similar to waters of an irrigation ditch—"Lots of water up there but only a trickle when it reaches here."

They heard the merits of many proposed projects explained, such as the Missouri-Souris, the Middle Rio Grande, the Gunnison-Arkansas, the Blue-South Platte. And the final 2 days of their trip were spent high in the Rocky Mountains in Colorado—2 days of driving in the snow, inspecting the Colorado-Big Thompson project. Yes, on this trip they saw everything: Beautiful farmlands, splendid crops, and the winter snows.

But "seeing" wasn't all the Congressmen did. They listened generously and often. Literally dozens of meetings were held, with many different groups. Chambers of commerce, Lions, Kiwanis, Rotary, reclamation organizations, joint meetings of all varieties; with Governors of the several States; with organized labor; with farmers; with representatives of private and public utilities; Government officials; dozens of newspaper and radio conferences. They were talking with people everywhere, finding out what they were thinking, and seeing what would be needed next year to make America great insofar as the activities of the Department of the Interior were concerned.

"We're the All-American Committee," Congressman Schwabe told the audiences. "We like our job of inspecting this great West because this is truly the only way to find out about America!"

When the Needles, Calif., Chamber of Commerce told the members about the damage done by siltation in the Colorado River and how part of their town was now just a swamp, the Congressman determined that the best way to really know was to get into an amphibian boat (or "duck") and see. When the Park Service mentioned that additional funds might be needed for work on the donkey trail to the floor of the Grand Canyon, a trip to the bottom was taken. (And that's work, riding a mule 11 miles up and down the canyon in less than 8 hours.)

What commitments did the visitors make? "To give each and every project full and complete consideration" when the committee meets in formal session in Washington. Equipped with a better knowledge of the details through the intense investigation of practically every Reclamation project and Interior Department activity in the West, the committee is now fully informed about the West. Nothing short of sympathetic understanding and assistance can result. •

NOTES FOR CONTRACTORS

Contracts Awarded During November 1947

Spec. No.	Project	Award date	Description of work or material	Contractors' name and address	Contract amount
1916	Fort Peck, Mont	Nov. 26	Circuit breakers and disconnect switches	General Electric Co., Denver, Colo	$37,446
1916	do	do	Transformers and lightning arresters	Westinghouse Electric Corp., Denver, Colo.	167,930
1916	do	do	Transformers and circuit breakers	Allis-Chalmers Manufacturing Co., Denver, Colo.	117,642
1924	Colorado-Big Thompson, Colorado.	Nov. 20	Electrical equipment for Marys Lake and Estes switchyards, schedules 5 and 6.	General Electric Co., Denver, Colo	63.285
1931	do	Nov. 10	Transformers and lightning arresters	Westinghouse Electric Corp., Denver, Colo	77,150
1931	do	Nov. 7	Voltage regulator and circuit breaker	General Electric Co., Denver, Colo	19,017
1931	do	do	Disconnect switches	A. B. Chance Co., San Francisco, Calif	5,297
1936	Boise, Idaho	Nov. 19	30-ton traveling crane for Anderson Ranch Dam	Marias Crane & Hoist Co., Philadelphia, Pa	18,710
1943	Central Valley, Calif	Nov. 18	Radial gates for Delta-Mendota Canal	Pacific Coast Engineering Co., Alameda, Calif.	16,020
1944	do	Nov. 20	Construction of switchyards for Keswick power plant	Hams Brothers, Sacramento, Calif	361,151
1949	do	Nov. 12	Doors and windows for Keswick power plant	George T. Gerhardt Co., Inc., San Francisco	30,688
1953	Davis Dam, Ariz.-Nev	Nov. 25	Bulkhead gates for Davis power plant	Independent Iron Works, Inc., Oakland, Calif.	35,878
1956	Boulder Canyon, Ariz.-Calif.-Nev.	Nov. 14	Electrical equipment for Boulder City water supply pumping plants	Westinghouse Electric Corp., Denver, Colo	13,324
1958	Tucumcari, N. Mex	Nov. 17	Construction of bridges and inlets, Conchas Canal	J. A. Terteling & Sons, Boise, Idaho	95,220
1959	Missouri Basin, Colo.-Nebr	Nov. 25	Construction of Sterling-Sidney transmission line	Utilities Construction Co., Nashville, Tenn	318,280
1961	Davis Dam, Ariz.-Nev	Nov. 14	Erecting 20 prefabricated residences	John Bohannan, Pacific Palisades, Calif	72,900
1962	Missouri Basin, Mont	Nov. 19	Construction of streets and utilities for Canyon Ferry Government Camp	Kiely Construction Co., Butte, Mont	153.131
1980	Tucumcari, N. Mex	Nov. 24	Construction of Saxon lateral	J. A. Terteling & Sons, Boise, Idaho	28.642
6 R1	Minidoka, Idaho	Nov. 25	Construction of laterals, Gooding Division	The Shoshone Co., Twin Falls, Idaho	19,225

Construction for Which Bids Will Be Invited During January 1948

Project	Description of work
Central Valley, Calif	Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.
Do	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado	Erection of a 162-by 70-foot steel warehouse at Wilds Spur.
Do	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on Big Thompson River, a 1-mile tunnel, 12 concrete siphons, 1 steel siphon, and other structures.
Columbia Basin, Wash	Construction of various features in the vicinity of Grand Coulee Dam as follows: Production of concrete aggregates for all remaining construction, completion of right power plant control building, completion of right power plant control tunnel, construction of right power plant switchyard, construction of transformer circuits R–1, R–2, and R–3, construction of tie circuits T–1 and T–3, completion of right power plant parking area.
Hungry Horse, Mont	Construction of Hungry Horse Dam (arch-gravity, concrete) and power plant.
Klamath, Oreg.-Calif	Enlargement of concrete pumping plant D.
Missouri Basin, Frenchman-Cambridge unit, Nebraska	Construction of earthwork and structures for 12.5 miles of Cambridge Canal.
Riverton, Wyo	Construction of lateral system on Wyoming Canal extension from beginning to station 1606.
Yakima-Roza, Wash	Construction of one 48 cubic-feet-per-second, and one 33 cubic-feet-per-second concrete pumping plant for pump areas 13 and 14 on Yakima Ridge Canal.
Do	Construction of earthwork and structures for approximately 14 miles of laterals for pump areas 13 and 14.

Bureau Conservation Conference

(*Continued from page 18*)

younger employees, both in the subject of irrigation operations on a regional level and on actual project operation.

The committee on land use and settlement considered the question of development work, prior to settlement of new Bureau of Reclamation projects on public lands. In the committee's opinion, it would be possible to construct more economical projects than generally have been built in the past, by clearing, levelling and roughing-in the water distribution systems. This would mean quicker returns for the farmer and enable him to conduct his operations with smaller amounts of credit. Where private contractors can make such a service available to entrymen at reasonable costs, the entrymen should be encouraged to use the private contractors, although the Bureau should usually offer such services on public lands, the report stated. When the cost of land development equipment is high in relation to the area to be developed, it was suggested that such equipment might be shared by several projects so that the cost could be prorated.

The committee on allocation and repayments advocated, among other things, that every repayment or water use contract, both new and amendatory, contain adequate provisions covering land use and conservation of water, with the understanding that such provisions will be carried out by the water users under the auspices of the district. It also recommended a simplification of contract language.

Hydrologic Conference Series Planned

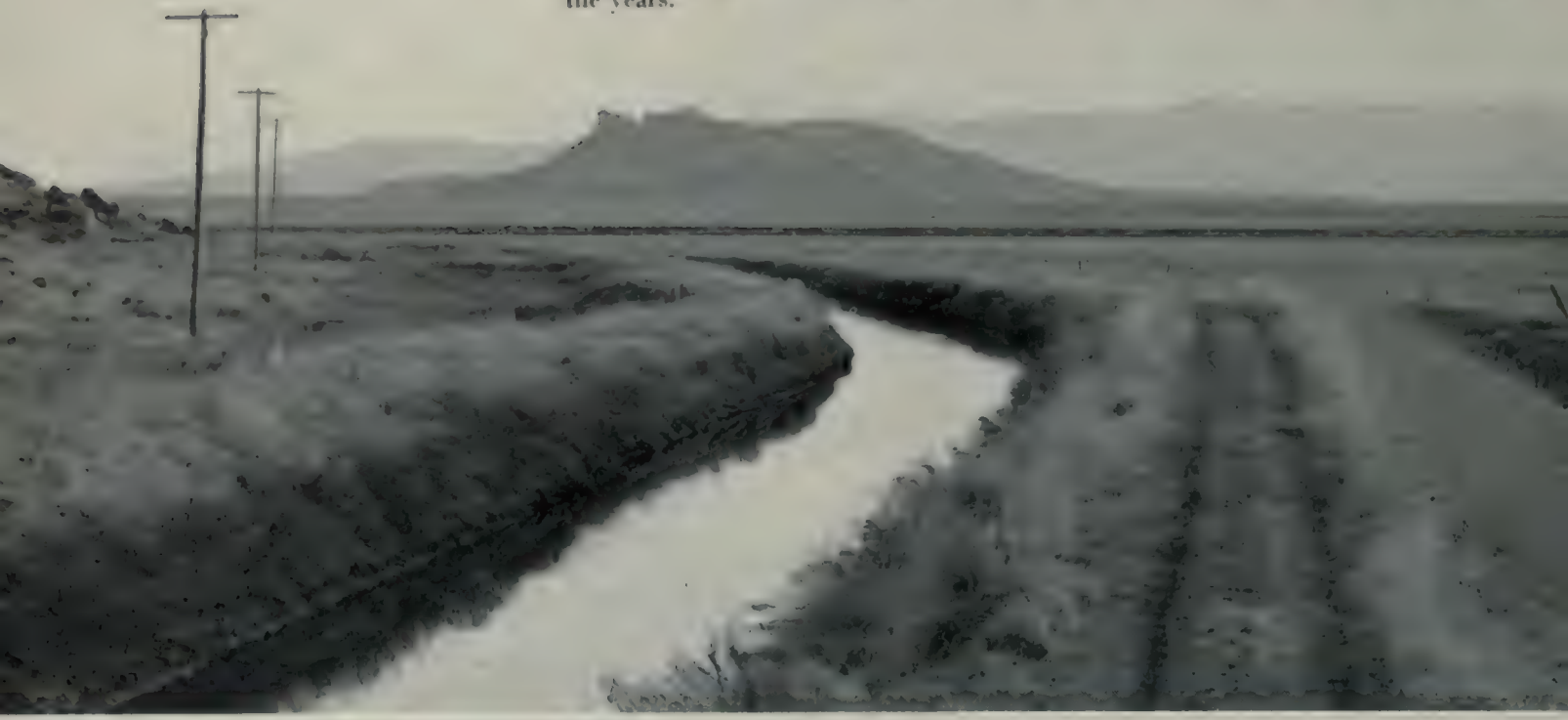
The first of a series of hydrologic conferences of Federal agencies for the purpose of correlating their needs in the extension of the hydrologic network will meet in New York January 14–16, 1948. Similar meetings will be held subsequently in each watershed. In view of the importance of coordinated hydrology in the Missouri Basin and the reflection in later watershed meetings of the policies and decisions reached at the first conference, V. A. Koelzer and W. U. Gartska will represent the Bureau at the New York sessions.

Cooperative Seismological Studies Okayed

Cooperative seismological studies through fiscal year 1948 at Hoover, Grand Coulee, and Shasta Dams and initiation of such studies at Hungry Horse dam site are provided for in a memorandum of agreement among the Bureau of Reclamation, the Coast and Geodetic Survey, and the National Park Service recently approved by Assistant Secretary of the Interior William E. Warne.

Such studies furnish scientific earthquake information of value to designing engineers, determine whether earth movements are endangering dams or appurtenant structures, where the movements originate, and furnish data for considering stress conditions.

FROM SWAMP TO SETTLEMENT—On the upper half of the page, J. E. Fluharty's photo of the drained lands of Tulelake, Oregon. Below, G. V. Gideon's copy of a picture taken on June 9, 1905, from the same spot. Bloody Point in the background remains the same, but the foreground shows the results of development through the years.



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Featuring:

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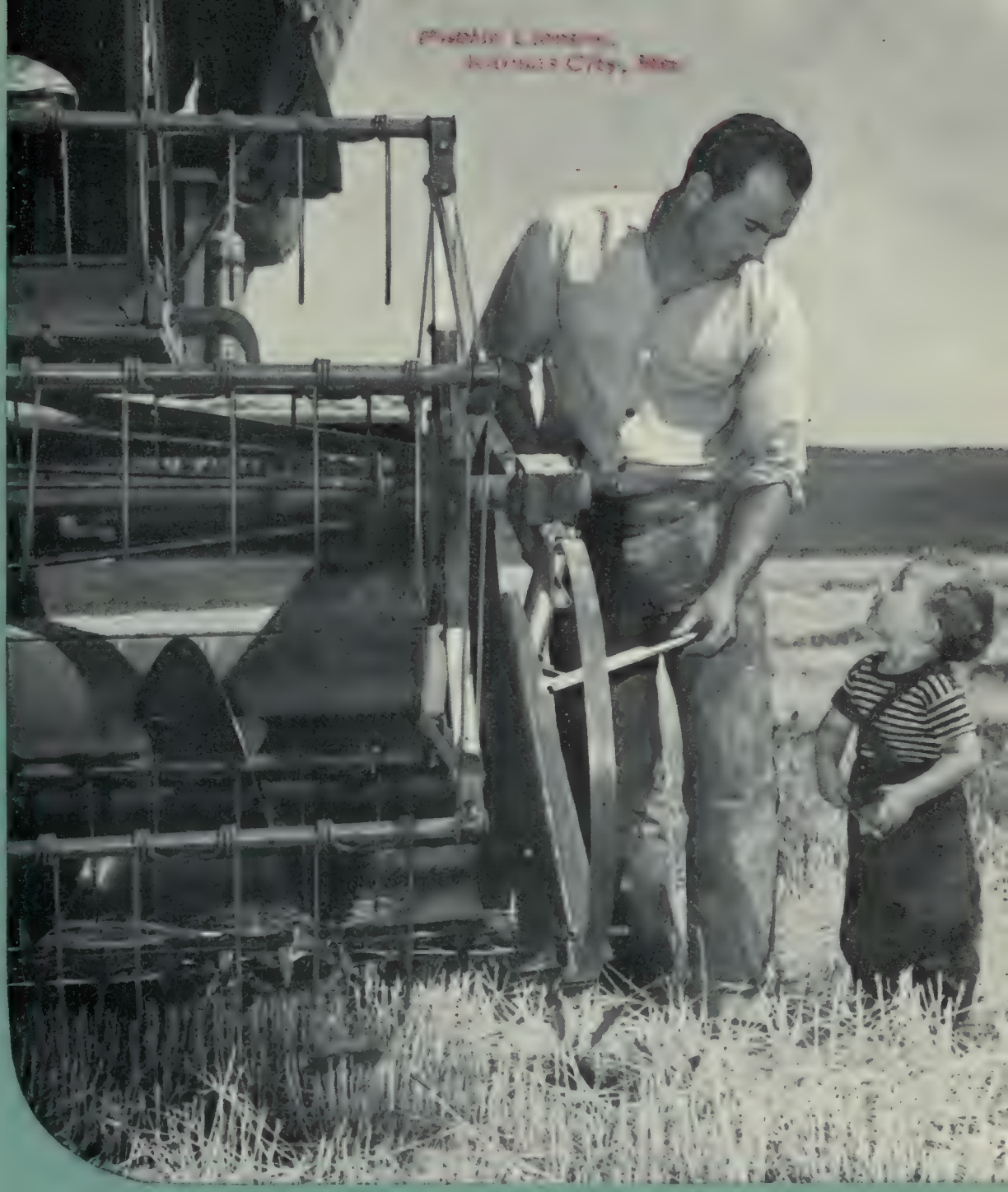
by
Constantin P. Christopoulos

Why Our Conservation Program Must Work
by Oscar L. Chapman
Under Secretary of Interior

GOLDEN HARVEST
at
KLAMATH



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THE Reclamation ERA

United States Department of the Interior

J. A. Krug, Secretary

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Reclamation ERA

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Ruth F. Sadler, *Editor*

Our Front Cover

Klamath Combine

Little man begins a busy day as he willingly gives "advice" to his dad, homesteader George A. Douglass, Jr. Little man is Eddie Douglass—See "Golden Harvest at Klamath," page 30. This photo was taken by photographer J. E. Fluharty of Region II in September 1947.

Letters to the Editor

Comments From Canada

3 Glenholme Avenue, Toronto,
November 28, 1947.

GENTLEMEN: The writer had the joy of attending the Convention of the National Reclamation Association held recently at Phoenix. On my journey to Phoenix, I examined Bureau projects in Utah, Nevada, and southern California, and on my journey after the Omaha Convention of 1946 I examined Nebraska, Colorado, and Wyoming projects. I cannot praise too highly the marvelous "works" and achievements of the Bureau of Reclamation. I am convinced that the crop returns on the reclaimed acres in all those low-moisture Western States, thanks to the magnificent achievements of the Bureau of Reclamation, do more than any other single agency to enable the United States to play the major part she is playing in European rehabilitation in food.

The Bureau has plainly demonstrated that reclamation is not a cost but is a strikingly profitable national investment.

At Phoenix one of the pamphlets issued the delegates was entitled, "Altus, the Irrigation Pioneer of Oklahoma."

About this project, may I ask for a little information:

1. What was the acreage of the project under water in 1947?
2. What was the value of the farm production, grain, stock, etc., in 1947?
3. What horsepower of electric energy was produced on the project in 1947 by the water; what was its value, or rather what was the money return from the electric energy?
4. What is the population on the project?

Personally I was thrilled with what I saw of results of the Bureau's projects. To mention only two, the Platte basin and the Salt River basin are both living examples of the remarkable benefits to the Nation that accrue from water conservation and its use for irrigation and power.

Yours faithfully,

JOHN R. MACNICOL.

Mr. MacNicol was thanked for his remarks concerning the important role that Reclamation projects have achieved in American agriculture and their probable influence on the program for European rehabilitation. He was also told that the Bureau is putting forth every effort to see that more irrigation water is made available in the next few years so that additional food may be produced when it is so badly needed.

His questions as to the W. C. Austin project (formerly the Altus project) in Oklahoma were answered, to some extent, from preliminary information for 1947. Crops had not been completely harvested, but a complete report was expected by January as to the results of irrigation during 1947, and as the ERA goes to press these data were being sent to him. Replies to his questions were as follows:

1. There were 3,686 acres in cultivation during 1947 which received an irrigation water supply. Of this area, 2,209 acres were planted in cotton.

2. The total gross value of the crops raised on the above acreage in 1947 is now estimated as $410,695, or an average of $111.42 per acre. This contrasts with a return of $27.46 per acre for crops grown on the project lands which were not irrigated. Of the total irrigated crop value, $312,362 was the value of the cotton; $67,206 for alfalfa hay; $30,166 for grains; and the remainder in miscellaneous crops.

3. No power development is contemplated on this project because of the low head available and lack of water regulation below the reservoir to coordinate the erratic irrigation demand of the project with power requirements.

4. There are 505 farms on the project and the population on these farms is approximately 650. The 5 towns on the project have a combined population of 12,950.

We are glad that Mr. McNicol had the opportunity to visit so many of the Western States and hope that he will return to see the rest of them.—Ed.

Greetings From Greece

4 Churchill Street, Athens, Greece.

DEAR EDITOR: Well, I've been on the job 3 months and haven't got a story for you yet, but so help me I will yet.

Thanks for the ERA; it is arriving every month, is dutifully read and passed on. Congratulations on it. It is getting better all the time.

At present, I am in the Corps of Engineers as a consultant on loan from the State Department.

The work is very interesting and I have never regretted for a moment that I came. The training in the United States Bureau of Reclamation was far more than I needed for the job, so I'm really enjoying the assignment.

Regards to all the gang and to all a Merry Christmas and Happy New Year.

ED CORFITZEN.

Eulogy From Egypt

EGYPTIAN ROYAL SOCIETY OF ENGINEERS,
Cairo, Egypt, October 22, 1947.

DEAR EDITOR: This acknowledges with thanks receipt of the September number of ERA. The features embodied in the number make very interesting reading and in particular Sawyer's article on Sprinkler Irrigation in the Willamette Valley. You might be interested to know that I am an irrigation engineer who had considerable experience in Egyptian irrigation, and naturally the article attracted my attention and interest.

Thanking you once more for your kindness, I remain,

MICHEL BALADI,
Associate Member,
Egyptian Royal Society of Engineers.

Errata note on Gila opening

The closing date for simultaneous filing of homestead applications specified as March 29, 1948, in the January issue of the ERA has been changed to March 30, 1948.

Chapman Addresses Kansas Engineering Society

Oscar L. Chapman, Under Secretary of the Interior, was the principal speaker at the annual meeting of the Kansas Engineering Society held in Topeka, Kans., on January 23. The theme of Secretary Chapman's talk was the Missouri Basin development program and its effect and benefits on those living in the basin area.

_____
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Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

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Why Our Conservation Program Must Work

by Oscar L. Chapman, *Under Secretary of the Interior*

WITH THE HUMAN RACE facing its greatest period of trial in modern history, the part which wise use of natural resources probably will play in national survival is coming into the spotlight. Manpower, food, minerals, fuel and electrical energy, every form of raw material, have become of enormous importance for the rebuilding of a damaged European civilization, and for our own survival.

Today this Nation is engaged in trying to bring about the survival of Democracy in the fatherlands from which the people who comprise this Nation came. But we shall be of little aid to the world unless we maintain an economy approaching full production. If we allow ourselves to slip into another depression, if we allow the purchasing power of the lower and middle income groups to be any more seriously impaired by inflation than it is today, if we allow our ideas of political freedom to be paralyzed by a fear that our own democracy is not strong and healthy enough to withstand without special props the impact of foreign ideologies, we may find ourselves slipping into a way of life that could be extremely unpleasant.

Of one thing we can be certain—the world's need for all forms of energy-producing materials, both foods and fuels, and almost every kind of industrial raw material will continue to be very great for a number of years. Only if we save ourselves by preserving our economic health can we hope to save others.

There are three outstanding reasons why the world requires so much more food and raw materials than ever before.

Despite the decimation of war, modern medical and engineering science have made a greater population possible than ever before, and the number of people in the world continues to increase rapidly. Even our own population, which seemed a few years ago to have been approaching an upper limit, has taken a new spurt, and will continue to expand for more years than we at first anticipated.

Secondly, the rapidly advancing technological command which man is attaining over the material universe makes it possible to use a much greater variety of materials in processing and manufacturing, so that we use more types of material, and in larger quantities. A spectacular example is the processing of fissionable material which produces atomic energy. Also, a rapidly changing technology means a more rapid replacement of productive equipment than formerly.

And most important of all, during the war we increased the material standards of living of the lower income groups so that they eat food that is more nourishing and more of it, wear better clothing than ever before and hope some day to live in better houses.

For all of these reasons we require more food—more iron, copper, zinc, tin and other metals—more fuel and electrical energy, than at any time in our history. And yet our supplies of some of these materials are becoming exhausted or extremely tenuous.

Let us consider one resource alone—agricultural land. The Secretary of Agriculture recently testified before the House Committee on Agriculture that, even allowing for a continuation in the march of technology with intensified fertilization, adoption of improved varieties, and other improvements, this country would require more than 415 million acres of crop land. This compares with 408 million acres under cultivation last year and an average of 406 million before the war.

This also envisages checking the loss of soil through erosion and depletion by the adoption of modern soil conservation methods—a situation which some agricultural economists tell us will require 50 years on eastern farms alone, before annual soil gains begin to equal annual soil losses.

A recent study made by the Bureau of Agricultural Economics showed that the West more and more will absorb the food it grows; and that the East must depend more and more upon the regions east of the Rocky Mountains for its supply of beef and lamb.

Other studies indicate in only a few years this country will be consuming more food than it produces, and must depend upon imports.

Thus, it is tremendously important to our national future that every foot of good agricultural soil be preserved, and improved with use if possible.

We could go on to explain the problems which the country faces in conservation of oil, gas, and coal—in the conservation of iron ores, copper, zinc, lead, many other metals, phosphates, and other nonmetallic minerals. Most of you already are familiar with the need for conservation of grazing lands and the preservation of fish in our western rivers.

But we cannot stress too much the necessity for preserving and prolonging the life of Reclamation projects, so that they will serve posterity for as long as possible. This is an enormously vital task. That is the Bureau of Reclamation's share of the Department's program. (See page 8, January 1947 RECLAMATION ERA.)

The Department of the Interior is not the only agency concerned with conservation of national resources. Anything which tends to make men, women, families, communities healthier, happier and more effective is conservation—conservation of human resources. Health and housing programs, in a way, are conservation programs. And in an important way the development of recreational areas in the West is a program for physical and mental health.

The soil conservation program of the Department of Agriculture is enormously important. But the Bureau of Reclamation's program for the prepetuation of the projects it builds is important also.

In 45 years we have spent about a billion dollars on Reclamation projects. Projects now under construction will cost at least that much again. And the long-range program envisages the expenditure of many more billions.

In planning these projects we would be neglectful of our duties and short-sighted in the highest degree if we were to plan only for the span of our lives—or even for another generation ahead. The duration of these projects probably can be extended two and three times what appears to be their present life expectancy, if we attack the problem of erosion by reforestation of our watershed hillsides, revegetation of the cover of our vast grazing lands, and preservation everywhere of the good soil that washes into our streams.

If we are to do this job as we should, however, we cannot afford to accept any short-term viewpoint. We may feel justified in destroying communities with bombs in time of war, but to build communities up in times of peace only to permit them to decay within a generation or two is neither good sense nor humane. We should make the resources which have been entrusted to us last as long as we possibly can.

Minus animal power, and with manpower depleted, the women of China must work the rice paddies to survive. *Photo courtesy of UNRRA.*

IMPRESSIONS OF CHINA

by Constantin P. Christopoulos

Conservancy Advisor for North China and Manchuria, United Nations' Relief and Rehabilitation Administration

When I was asked to write for the RECLAMATION ERA and its farmer-readers something about my recent experiences with China and her farmers, I might say the anxiety of the editors for having the American farmers well informed and possibly entertained, impressed, or better say moved, me much.

Having myself farmed and having been in close touch with farmers in several countries all my life, I have not even the least doubt that farmers everywhere form the best and the most stable foundation of the human community. From the farmer all other social classes originate and soon degenerate. The farmer, away from the turmoil and the corruption of the big city, keeps healthy physically, mentally, and morally. He emanates his eternal health to all society.

The editors of the RECLAMATION ERA are right. The farmer becomes a much more influential factor in the human community as he is kept well informed and decently entertained.

In these few lines I would like to be more entertaining to my farmer friends of the West and less of a lecturer or even an engineer.

People everywhere upon our earth are basically the same. Everywhere they have fundamentally the same human nature and the same good and bad motives in life. However, above this common basis people branch off and develop in a different way in each country. The people of each country develop their own common characteristics, different from those of other nations, according to their origin, to the nature of their country, its geographic position, its history. All these four factors have an overwhelming bearing upon the physical, the mental and the moral attitude of their inhabitants. Obvious as these things may be, they are often ignored, or more often misunderstood, and this ignorance and misunderstanding has had some of the most lamentable effects on the peace and prosperity of the world.

China is a country essentially different in nature from the United States and has a history entirely different from that of all America and much different from other countries. Consequently, the Chinese people—probably not worse nor better qualified naturally than the people of the average nation—have developed a way of living and an outlook of life differing essentially and in many respects from those of other nations.

Over 450,000,000 people live upon an area almost equal to that of the United States, with its population of 140,000,000. Obviously there is not enough land in China to go around. The average farm area cultivated by one farmer does not exceed 5 acres, sometimes in several unfortunately located parcels, but usually of an excellent quality. The moisture in China is abundant for crops—except in North China, where features of desert are prevailing. In the southern two-thirds of China, where rains are frequent, rice is the prevailing crop and main food. In the northern one-third, where rains are scarce all the year around except July and August, the prevailing crops and main foods are wheat, kaoliang, millet, and soybeans.

Animals in China are rare. People cannot afford to feed them, and they themselves eat the grains, use the hay as housing material and fuel, and do almost all the work which is done by animals in other countries.

The scarcity of land has pushed the Chinese farmers to cultivate their lands with their own hands and with the utmost care. I understand that Americans like to believe that they excel in everything. But I have enough respect for my readers to be able to tell them that from my impressions the Chinese farmers, most skillful and laborious, are probably the best in the world as far as cultivation and productivity of land are concerned, regardless of cost and profit. They do not consider the cost of human labor. They have an over-excess of it.

They have developed elaborate and interesting technics and tools for cultivating in mathematical straight-lines the strips of their land, and for draining or irrigating them, all by hand.

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THE AUTHOR, Mr. Christopoulos, is well-known to the readers of the RECLAMATION ERA for his article "Old and New World" which appeared in the December 1936 issue. At that time he had concluded a year's residence in the U. S. A., had made a study of the Bureau of Reclamation and toured the reclamation projects in this country. Professor of the University of Thessaloniki, Saloniki, Greece, civil engineer, and former Chief Engineer for reclamation works in southern Greece, he was also a Rockefeller Fellow for the Study of Engineering in the United States in 1936. Having recently returned from North China, Mr. Christopoulos is in the enviable position of being well-acquainted with irrigation in three countries—Greece, a nation of revered antiquity, the United States, a relative newcomer in the world scene, and China, one of the most ancient of civilizations.

Here, he is shown holding the plaque presented to him by the North China Conservancy Bureau. It bears the inscription "To Professor Constantin P. Christopoulos IN APPRECIATION OF HIS INVALUABLE SERVICE, October 4, 1947."

The scarcity of land has pushed them to other extremes, too. They take the utmost care to utilize for their crops every possible type of fertilizer including human (called "night soil") and animal. This is why shallow ground waters have been polluted; no one dares drink unboiled water, and few dare eat raw salad in China.

Regarding irrigation, it is extensively practiced for raising rice mainly in "wet" China, where extensive canal systems provide water, which is then elevated to the land surface mostly by manual power with some very crude and some very ingenious devices. In "dry" China, north of 34° north parallel, little irrigation is practiced owing to the lack of provision for it, according to my observations.

The United Nation's Relief and Rehabilitation Administration (UNRRA) under the inspirational leadership of a brilliant American, Harlan Cleveland, besides assisting in the flood control and reclamation of millions of acres, has even more essentially caused the vital question of irrigation to be squarely faced in North China. It has helped conduct research work, and established principles of economics and engineering, for an over-all water plan in the northern one-third of China Proper, covering an area of about 650,000 square miles and populated by nearly 100,000,000 people, almost entirely farm families. By irrigation, flood control, and drainage, ultimately an increase of land production is contemplated up to two or three times the present yearly average.

Furthermore, UNRRA contributed substantially toward the construction of the first high dam to be started in that area. This project, the Kuan-Ting Dam, of concrete, gravity type, nearly 150 feet high, on the Yung-Ting Ho (Ever-Stable) River near and to the northwest of the former imperial capital, Peiping, was originally planned for flood control, but at the advice of UNRRA it will be eventually turned into a multiple-purpose project on the basis of the aforementioned principles aimed chiefly at utilizing the flood waters for irrigation.

Irrigation is the primary means available for promoting the well-being of the farmer especially in North China, where the climate, besides being dry, is too cold for more than one crop yearly. In Central China (the Yangtze River Basin) two crops a year are the rule and more southwardly three crops are not unusual.

China is known as the country where famine often occurs. Lack of communications and isolation of villages are secondary causes of this inhuman circumstance, which is mainly due to floods and droughts in both the "wet" (rice) and the "dry" (wheat) regions.

Irrigation works, flood control, and drainage systems are of paramount importance for all of China. Without them the Chinese farmer will continue to be the victim of nature's adversities and live a life at the bare subsistence level.

Whether we like it or not, we are all human beings and live in the same one and physically indivisible world. The fate of our fellow men and cohabitants of this globe sooner or later, in some way or another, will affect our own life in our own homes. Care for the well-being of all men on earth is the moral duty and to the material interests of everyone. It is most regrettable that this plain truth escapes the attention of many people even in our age of the flying boat and atomic energy.

Helping China and other overpopulated and under-developed countries to take full advantage of their own natural resources and stand on their own feet is the duty of and to the interest of all. China at least has a tremendous amount of latent natural resources: abundant waters, enormous coal deposits, rich and widespread mineral ores. All that she needs badly is peace, the spark for improving social conditions, and a plan for the development of her economy.

The cultural side of the Chinese farmer's life is not less interesting to the farmers of other countries and especially of America. China is the cradle of all Eastern civilization. What Greece is for the West, China is for the Orient.

It is well known that our western civilization is distinguished first for that way of rational thinking and reasoning that is called Science; second for that way of governing the community that has been derived from the Roman law; and third for that moral attitude that is known as Christian religion. All these three influences upon our everyday life originate chiefly from the idealistic and none-the-less rational Greek mind and philosophy. Most properly one of the leading thinkers of our day has recently written that all so-called westerners are Children of Greece.

Similarly one might say that all so-called orientals are "children of China." Of course the oriental civilization is essentially different from that of the western world. In fact, the Orient has not developed any science by itself; but it has developed fine arts of its own, entirely different from those of the West, and a number of religions and practical philosophies of life, both more or less materialistic and superstitious.

But this is neither the proper place nor the right time to discuss such questions. What should be said here is that both western and eastern civilizations and cultures must inevitably develop one working philosophy of life common to all mankind, or—and the answer to that you already know.

Unlike the goddess Athene who sprang from the head of Zeus, neither the western nor the eastern civilization and culture sprang up spontaneously and suddenly from certain privileged minds. On the contrary, any civilization and culture has gradually grown up from seeds deep-seated in the souls and minds of people living in close touch with nature, that is to say, the farmers. From such seeds grew gradually the epics of Homer, the Greek Mythology, Religion, Art, and Philosophy. From such seeds in the souls and minds of the Chinese farmers grew the Chinese practical philosophy of life that was later expressed by Confucius in his Classics, where, in stratifying the social classes, this eastern philosopher put first the scholars and the farm-

ers, and then the other professions, the last one being the military.

What is still more interesting is that the deeper a civilization and culture has its roots in the souls of the farmers, the longer it survives. The students of ancient birthplaces of the western and the eastern cultures will find roots of them alive in the folklore and everyday life of the Greek and the Chinese farmers respectively. Genuine and noble civilizations and cultures are probably expressed in big cities, but they are certainly created and preserved by the farmers who stick to their lands and prosper. No one has more right to raise his voice and govern this earth than the farmers of the world.

Regarding the Chinese folklore, it is more superstitious and artistic than philosophical and idealistic. But what mainly distinguishes the spiritual life of the Chinese farmer is his profound attachment to his own farm, where generations after generations have been buried in graves which are sacred and immutable and sometimes cover over 5 percent of the arable land.

Equally cardinal features of the spiritual life of the Chinese farmer are his respect for his elders, the scholars, and the criticism of the community; but more than anything else characteristic of the Chinese is his unlimited devotion to his family and his ancestor worship. His family is his only world for the Chinese farmer who has very little, if any, social life.

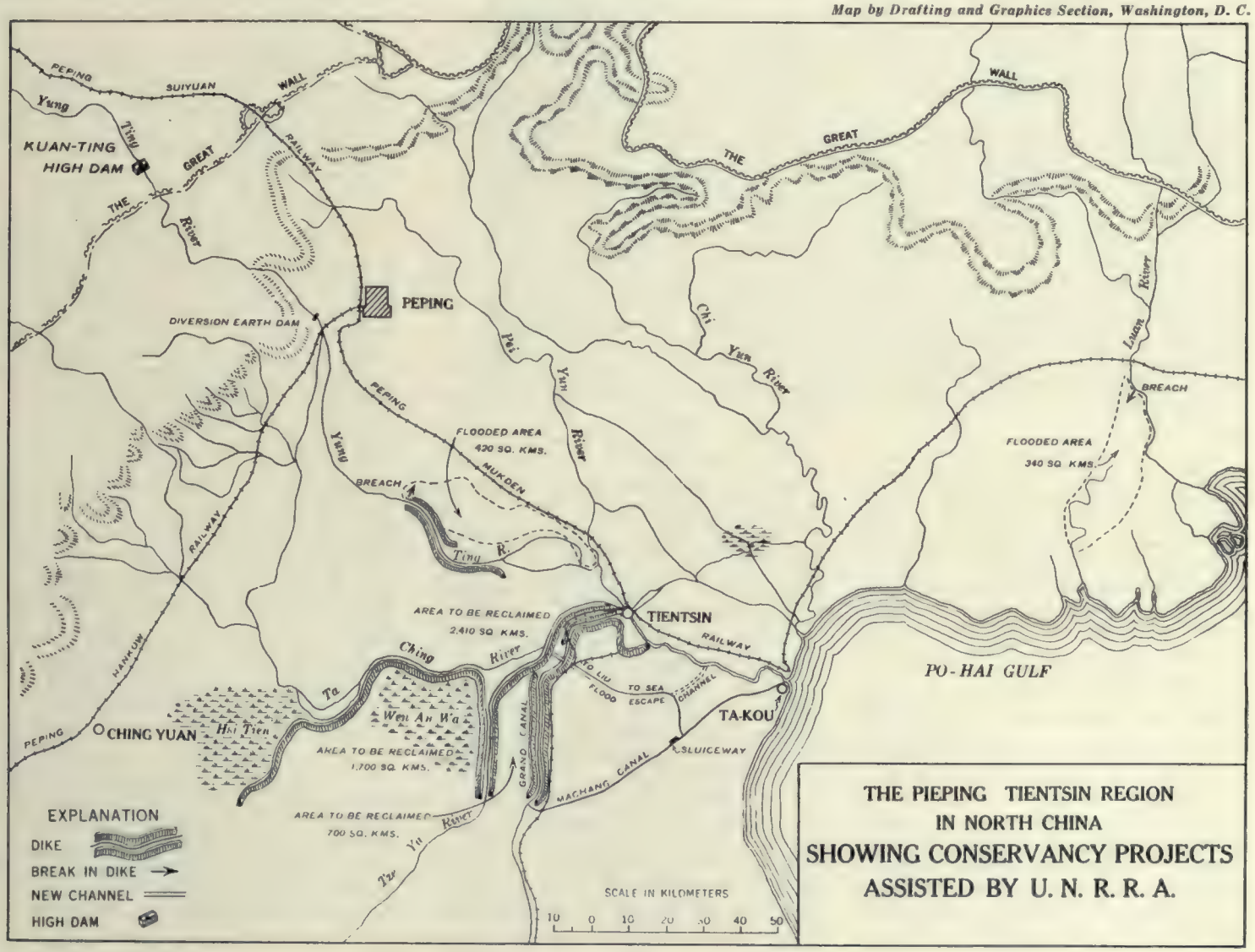
The best of these cultural traditions of the Chinese farmer through innumerable generations upon the same piece of land account for the preservation of this people through milleniums and innumerable adversities of history, and for the growth of the country to the largest nation of the world.

With such a nature and economy, so long a history and such deep-seated traditions, it is quite natural for the western visitor to China to find there things he likes and things he dislikes, some that should be changed and some that should be preserved. However, the unprejudiced visitor will soon become aware of the genuine democratic spirit and the sense of dignity and self-respect of the Chinese, even in the lower class, the "coolies."

When in such a country and nation, a westerner approaches the people with the preconception that he himself is by nature superior, that all that he sees there is bad, merely because it is different from what he is used to seeing in his own country; that all the real evil in that country is due to the defects of the people, and that all the real good in his own country is to be attributed to his own superior nature, this man, sooner or later, will become antipathetic, even if he goes there with the best intentions and with relief gifts. In the long run he may become hated by the beneficiaries of his relief gifts; especially in China where westerners have repeatedly mistreated the Chinese and approached them mostly with selfish intentions.

To this mental attitude, generally speaking, many of the evils in this world of ours are basically due. As long as we imitate the Nazis of the "Superior race," we shall continue to be unable to understand the reasons underlying the differences in the outlooks between the various nations, the reasons for the evil in other countries and the good in our own country. We shall continue to be unable to understand and help each other, unable to live in peace with each other and enjoy the beauties and blessings with which God has covered this mother earth of ours, and, first of all, mother earth of all farmers in the world. ●

Map by Drafting and Graphics Section, Washington, D. C.



How to Conserve Irrigation Water Supplies (Part Two)

By L. R. Fiock

Supt. Rio Grande Project
N. Mex.-Texas, Reg. V

Editor's Note: In last month's issue, Mr. Fiock outlined four major steps required to achieve maximum use of the water supply for ultimate crop production: (1) storage and release to meet irrigation requirements, (2) diversion of storage release or natural stream flow, (3) operation of the distribution system, and (4) delivery of water to farms. He completes his discussion in the following article.

Preparation of Land for Irrigation

Proper land preparation for irrigation depends upon topography, type of soil, kind of crop to be grown and method of irrigation. Whether the irrigation method be surface flooding, bordered tables, beds, furrows or corrugations, the most conservative and efficient use of water requires a fine balance between type of soil, slope of land, length of runs, and head of water applied.

If the soil is sandy or light and the slope too flat, the runs too long, or the head of water too small, the upper end of the field will be over-irrigated before the lower end has received sufficient water. Excess water absorbed at the upper end constitutes waste and may result in a rising water table.

Where the soil is adobe or heavy and the slope too steep, the runs too short or the head too large, the lower end of the field will be flooded before the upper end has absorbed enough moisture. This again constitutes water waste and may result in drowned crops at the lower end and a rising water table.

Each farmer must, by trial and test, gain knowledge about his soil, slope of land, length of runs, and head of water to achieve the right combination of land preparation for successful operation. Little, if anything, can be done about soil types. Desired slope can be achieved by land levelling if the cost is not too great. Length of runs usually can be established to match conditions, but the irrigation heads or size of streams turned into each table or furrow should always be regulated, adjusted, and fitted to other conditions, thus effecting a proper balance.

Land should be levelled to a uniformly smooth plane surface. The proper slope of irrigation furrows depends on the type of soil and length of run. Depressions which impound water become over-irrigated and may injure the crop as well as raise the water table. High spots will receive insufficient water. Water run on surrounding land, long enough to reach high spots, over-irrigates the lower parts of the soil. Such conditions result in waste.

Use of Water on Land To Produce Crops

The basis for ownership and retention of a water right is beneficial use of the water. Consequently, it is to the interest of the property owner, whether he is a resident farmer or conducts his farming operations through a manager, foreman or tenant, to apply every known principle for maximum conservation and beneficial use of the water supply.

The most conservative use of the available water supply is that which results in maximum crop yields. However, this does not imply excessive use of water to produce the highest possible yield per acre. In the application of irrigation water, a point is reached where the increase in yield is not in proportion to the additional water applied.

Each farmer must observe and study conditions and requirements and crops to be produced on his own place and then regulate his operations according to his knowledge and understanding of his peculiar problems. He may obtain help and advice from technical and agricultural agencies, but withal, he must adapt the general theories and principles to his own particular conditions.

Experiments on test plots, with complete records of irrigations and yields, will aid in determining methods that create optimum results.

There are no set rules that can be applied universally without judicious adaptation and variation, if necessary, to fit the immediate conditions and requirements.

Soil moisture and crop needs should be studied carefully at all times and irrigations regulated accordingly. This is essential to effect the proper combination of soil type, slope of land, length of run and head of water and also to give the crop just enough water to meet its requirements without a deficiency or excess and waste. This rule is especially important during and immediately following light showers, when assumed soil moisture conditions are often misleading. Project personnel must guard against crop damage from this cause, which in turn may bring forth an accumulation of orders that result in a peak demand on the system, often beyond its capacity to serve in a resonable time. Depth of soil saturation by irrigation or rain should be determined by using a probe rod or shovel to the depth of the root zone. Although a limited portion of the applied water must percolate through the soil to prevent accumulation of alkali salts on the surface, farmers must resist over-irrigation.

A rising water table, high water delivery charges, and water waste are companion evils of excess irrigation.

Where sufficient water is available, its application should be limited to an amount necessary to keep the crop in continuous healthy growth. Irrigators, especially those in the Rio Grande Valley, should not wait until the crop is suffering and then demand or expect immediate relief by delivery of water on short notice. Such a practice disrupts normal irrigation schedules and, if commonly practiced, leads to peak demands which cannot be relieved. There is then no alternative except to deliver regular irrigation heads on a rotation schedule or by deliveries, as near as possible, in the sequence in which orders are received. Careful observation of soil moisture conditions permits anticipation of water needs sufficiently in advance to allow storage releases on the basis of consolidated orders.

Delayed orders, whether due to a lack of accurate information on soil moisture conditions and crop requirements or postponement or cancellation of orders during periods of light rain showers, when soil conditions may be misleading, result in the loss of water released from storage to meet anticipated requirements. Water cannot be made available when needed and then used only as desired without waste, intermittent service, and disrupted operations.

Proper cultivation of plants during the early stages of their growth not only controls weeds but conserves moisture.

Plants should be forced to develop a deep root system during the early part of the growing season. This can be accomplished by avoiding over-irrigation. Too much water on young plants tends to develop a shallow root system which in turn requires frequent irrigation throughout the growing season. Properly developed root systems require less water, produce superior plants of better quality and give greater yields.

Ditches, gates, and boxes should be sufficiently large to handle maximum flows, and they should be kept clean. As a general rule, irrigations should begin at the far end of the field to avoid waste of a full ditch of water after the application has been completed. If the headgate is distant from the field, it should be closed soon enough to finish the irrigation without wasting a full ditch of water.

Irrigation abuses are often the fault of employed irrigators, especially if they are inexperienced. Farmers cannot expect best results unless their employees are properly supervised and required to use approved irrigation practices.

Crop and irrigation programs of individual operators, particularly for specialized and minor uses, should be adjusted to schedules established to meet major requirements. Adherence to such schedules is particularly important for fall and winter irrigations, when water runs are intermit-

(Continued on page 29)

British War Bride in the Wilderness

A boyhood ambition was realized, and a wartime dream came true, when Pat Ford became the caretaker at Bumping Lake and gave his wife, Doris, the "quiet home in the country" he had promised.

by Stanley Rasmussen,
Chief Photographer, Region I, Boise, Idaho

Photographs by the author

Doris Ford proudly raises Old Glory and anxiously looks forward to the day when it will be her flag, too.→

FOR the second time since coming to America from her home in Surrey, England, British war bride Doris Ford has gone into seclusion at Bumping Lake Reservoir of the Yakima Reclamation project, situated high in the Cascade Mountains of central Washington. Until spring she will see no one except her husband, Pat, and their 6-month-old son, Billy. Since the first heavy snow in November, Doris has been forced to restrict her activities to her home and the immediate area surrounding it. Until she learns more about the art of skiing she will probably stray no farther from her home than the distance she can throw a snowball at the man who took her to this wholesome outdoor life.

It was probably the most natural thing in the world that husband Pat was chosen for the position as caretaker of the isolated reservoir, replacing colorful Jack Nelson, who retired after 30 years' service. (See RECLAMATION ERA, December 1946.) Pat was born and raised at Goose Prairie, 5 miles from Bumping Lake and the post office for the rugged area. As a tow-headed boy he spent many happy hours romping around the reservoir and in the surrounding mountains. He recalls that he had some of his most exciting times throwing pieces of wood into the spillway waters and watching them drift off down the mountain stream. As he grew older he hunted and fished the area.

All of this time he was subconsciously storing up information about the duties of a caretaker as he followed white-haired Jack Nelson around during his frequent visits to the lake. Even though he had a hidden ambition to live the free and open life that was Nelson's, it wasn't until he had gone overseas that he realized that it might materialize. His mother wrote him about the position which was to be vacated at Bumping, and Pat immediately submitted his application.

That application was also the concern of another person, for Pat had married Doris White, a flight sergeant in the Women's Auxiliary Air Force. His promise of a quiet home in the country was to be taken more literally than she suspected at the time. It has certainly proved to be a lot different than anything that she had known in England.

Doris had become accustomed to being away from home while in the army but yet she adhered to a pattern of living wholly English. In Surrey, a suburb of London, where she grew up, she was constantly surrounded by a lively environment. She has six brothers and sisters—always a source of great fun. In direct contrast to the quiet life that Pat had known in the moun-

tains, Doris spent hers enjoying the ways of the big city.

When the time came for her to depart for America she claims to have experienced no qualms at the discouraging prospect of not seeing her English home and friends again for a long time. It wasn't until they were on the last lap of a pleasant trip—when the Fords alighted from the bus at Bumping Lake Junction en route to Goose Prairie—that Doris was abruptly initiated into the new life which was to confront her on a Federal Reclamation project. The 6 miles from the highway to Pat's home had to be traversed on foot, as the young couple had forgotten to inform Pat's folks of the time of their arrival, and thus no one met them at the bus. But Doris remembers that she was so intrigued by the contrast of the tall pine and fir trees to the sturdy oak and elms which were familiar to her in England, that she hardly noticed the long walk. This was the start of a rugged existence in the mountains of Washington for the attractive 24-year-old bride from the British Isles.

Pat is 23 years old—probably the youngest employee of the Bureau of Reclamation holding a position as caretaker of a reservoir. Each morning in the spring, summer, and early fall he receives word via short wave radio from the Bureau's Yakima office as to how much water is needed. He goes to the gate house and turns the wheel which governs the flow of the precious irrigation supply to the farms of the Yakima Valley. Just as vital to the efficient operation of this reservoir—one of six on the project—are the readings which he takes the year around at the weather station situated in his front yard. From these figures Weather Bureau officials predetermine how much water can be expected for Yakima's irrigated farms due to summer rains and how much storage can be expected through the winter's snowfall.

The maintenance of equipment and features of the dam keeps Pat busy for long hours during the late spring and summer months. The spillway must be tarred to prevent rotting. There are many logs and floating obstacles to be disposed of. When all of this has been done, there is a general clean-up of the reservoir to be made. Then too, he must be constantly alert against forest fires in the area. On several occasions he has notified the ranger station about fires he has spotted and then has joined them in fighting the blaze. Visitors are welcome but they bring with them the danger of fire.

When the Fords first took up their duties at Bumping Lake Reservoir they found themselves handicapped by an acute lack of transportation. What was needed was a conveyance which could serve many purposes. They wanted a vehicle which could be subjected to heavy duty and yet be used for an occasional run into town or for getting around on the rough mountain roads.

A surplus army truck seemed to be the answer but an extended search of car lots of the Yakima Valley disclosed only one on sale and it was priced at $2,100. That was definitely out of the Ford's budget range.

When it seemed that all hope for an answer to the problem had ebbed away, Pat's brother ran into their home one day with the solution. He had seen an army "duck" at a surplus sale in Yakima with a price tag of $750. One look at the massive piece of equipment was enough. They drove it home.

The "duck" serves a double purpose. It is used in the lake to pull stumps and tow obstacles. Formerly Ford had to use a small and inadequate motorboat. His present vehicle also fills the bill for transportation when the Fords find it necessary to run down to Goose Prairie for groceries and the mail. Doris derives a lot of pleasure from the strange craft, having learned to operate it when Pat took her on an occasional jaunt around the reservoir.

The 6-month isolation during the first winter made a change in Doris, unbeknown to her. Friends noted she had lost most of her English accent. She had also adopted some slang expressions from Pat, such as "once in a blue moon." While Pat may have succeeded in changing Doris' diction considerably, there are some English habits with which she refused to part. The most prominent of these is her inherent desire to sip tea at 10 in the morning and in the middle of the afternoon. And she must have toast and marmalade to go with it. Pat, like the rest of the boys who served in the armed forces, has developed an aversion to marmalade, but Doris still has it as regularly

At left, Doris "doubling in brass" as she takes message from Yakima project office, even if it does inconvenience Master Billy a little. Below, she and Pat check the anemometer to determine the wind velocity, just another of the many tasks connected with the caretaker's job.

as "Big Ben." She did try iced tea but says "I wouldn't give you a 'thank you' for it." She still wants hers hot, with milk, not cream, and with sugar.

The long winter provides Doris with a chance to try a recreation entirely new to her—skiing. She made several attempts at it during the snow season of 1946 but admits they were not successful. Taking short walks around the area on snow shoes had more appeal for her because she "found it not so difficult to stand up on them."

But outdoor sports are just one form of diversion which the Fords resort to in their search for amusement during the long winter days. Playing "monopoly" is another. Neither of them will claim the Bumping Lake championship but Pat was challenging no beginner when he played Doris. Monopoly is played extensively in England. Besides this unending game, the Fords can turn to a library of several hundred books in their living room. Woodworking is a pastime for Pat. Last winter he turned eight table lamps on his wood lathe from pieces of fir which he had seasoned. He sold the lamps to a nearby riding lodge in the spring when he could once again drive out to civilization.

Being cooped up for 6 months and finding an interesting diversion for all those idle moments is a test for anyone's ingenuity, but Doris claims, "I didn't mind it at all." Of course, since the arrival of Master Billy, the problem of what to do with leisure time has been much less acute! She does confess that during the long winter nights when she is sitting in front of a hot blazing fire in the huge fireplace, which resembles those found in English homes, she thinks too frequently of her folks back in England and the hardships which they are facing. Doris periodically sends a box of foodstuffs and clothing to her people.

Last summer much of Doris' time was spent in stocking the pantry shelves with a variety of foodstuffs to last them through the winter. The Fords made several trips to Yakima and loaded up on canned goods. This was something which Mrs. Ford really enjoyed, for she had spent many a fatiguing hour standing in queues in her home town. But the variety of the items which she was able to purchase posed a problem for her. There were a lot of cans about which she had never heard. This meant she had to learn all about American cooking and eating habits. She was lucky in this respect, however, for she had Pat in a spot where he had to take it or leave it.

Home canning was something else of which she knew nothing. Pat brought her some of the famous Yakima peaches and apricots and helped her preserve them. This venture was apparently successful for she said, "I was afraid that we wouldn't have any fruits left for winter the way that Pat devoured them."

When spring comes again to the Bumping Lake area and the Fords both can once more travel the now impassable road from the lake to Goose Prairie they will climb into their "duck" and take a week end to look up the friends whom they will not have seen for 6 months.

Most important of all, Doris will go to Yakima and make application for naturalization papers. She is now spending endless hours studying the history and constitution of the United States, so she can become a full-fledged citizen.

And when that happens she and Pat each morning will, more proudly than ever, raise the American flag to the tall pole in the front yard of their wilderness home in the West. ●

How to Conserve Irrigation Water

(Continued from page 26)

tent. Operation of the system for special deliveries to limited and scattered acreage is extremely expensive and wasteful. It also interferes with necessary maintenance work because there are certain nonirrigation periods when water must be out of the canals to accomplish necessary repairs.

Irrigation farmers should not gamble with irrigation water, especially when the supply is limited. The gain, if any, is not worth the risk. Preseason planting to attempt to force the growing season results too often in replanting and stunted growth. This, in turn, adds extra seed and farm operation costs, in addition to consequent loss of the stored irrigation supply. Crops planted in season, when germination and continued growth are assured, will usually outproduce those planted prematurely. ●

Army "duck" provides Pat and Doris with ideal transportation for this rugged country—being serviceable on both land and sea.

Golden Harve

**Tule Lake homesteaders, tal
lifetime opportunity, plus a h
fect timing, ideal locality, an
dented and perhaps never-to-
eff**

by A. D. Harvey a

Region II, Sa

Above, left corner—Harry H. Hundley home; extreme left, Mrs. Hundley helps Harry with lighting fixture; directly above, "house on wheels" barracks en route to new homesite; below left, Mrs. Hulse in her new kitchen; directly below, Frank Sullivan enjoying a repast.

If you were, like most of us who had to take American Literature in the late 1920's, fed an exclusive diet of Sinclair Lewis, Knut Hamsun, and Hamlin Garland until you almost cultivated a taste for their leaden epics of Life, Thwarted by the Rigors and Disappointments of Wrestling with Farm Problems on the Dour Midwestern Prairie, you are apt to regard this chronicle of the first crop-year among the 1946 Tule Lake homesteaders with faint disdain.

It definitely lacks "class"—that monumental quality evoked by the lurking presence of Fate near the family hearth, quiet, unobtrusive, but forever watchfully waiting, ready to flop her wet blanket and douse the tiniest glow from the embers of youth and hope.

For one thing, nature was particularly kind. A June frost looked bad, but the crops came through all right. The market was unusually favorable—even better than 1946. It was up to the levels of 1945, in fact, with barley bringing $5 a hundredweight. Credit was easy and ample and cheap. The long shadow of the banker, coming to grab the crop and tools, never darkened a single doorstep.

Fate was, thanks be, indifferent. And Fortune, which gave farms to the 86 homesteaders last Christmas, beamed down on them rather steadily all year.

There's little of the epic about the story of the year 1947 in the Klamath country. But if you're a normal, optimistic American who likes to see people happy and successful rather than bloody but unbowed; if you believe that money to spend is good stuff; if you quip naturally, "Well, Columbus took a chance"; then the adventures of the lucky 86 who got farms for Christmas presents last year will interest you. *You may even see it as a story of pioneering; for if half the pioneering spirit is willingness to endure hardships, the other and bigger half is willingness to gamble on a long shot.*

For that's the way it turned out at Tule Lake this year. Everybody was fairly happy, but those of the veterans who took the biggest chances were happiest.

Because of an inevitably late start, most of the veterans felt that the best way to assure the success of the first year on their farms was to lease their land to experienced operators at relatively high prices, and then by working with them, learn how the land ought to be farmed. Meanwhile, they could work on the two barracks each from the old WRA center which were allotted for hous-

at Klamath

vantage of a once-in-a-eat combination of per-rices, reap an unprece-icated reward for their

n Cassmore

, Calif.

tear them down for lumber to build anent houses, or reconvert them into looking shelter via siding and picture ows. Early in the year you heard so about this type of planning that you ht the whole area might be leased out. sudden wave of optimism seemed to over the newcomers at planting time. final result was that only 10 home-ers leased out all of their land. Only ased out any of it. Sixty farmed it all selves.

timism was justified. Last Novem-omesteader James Stearns said, "I fig-the best thing to do was to play it lease my land, work out; get the ings torn down and ready to build a next year. To my sorrow, I won't again." Here are the crop returns the 7,500 homesteaded acres that d his chagrin.

ose who leased out averaged a gross 5, and after deducting $500 for water other charges, netted approximately 5.

e rest of the homesteaders—those who ted all their land or operated most and leased some out—averaged a income of about $10,150. As nearly sts and production figures can be ad-d, their net return—over and above uction and maintenance costs—was a over $6,000.

ese were incomes from the homesteads . In addition, most of the settlers to have paid for groceries between time and harvest by using the GI bill ghts' provision which allows veterans siness or on farms to draw the differ-between their incomes and $100 a h. Also, many worked off their s at some time—on other farms, in otato sheds, as carpenters, or at other

few incomes soared far above the gen-average. Some homesteaders success-bid on project lease lands—lands not ufficiently reclaimed and developed to for homesteading which are leased or grain farming until they are ready. income from the lessees goes into ct funds and the leveling and draining do reduces construction costs. Seven rs who won out on the bidding for lands last spring added a gross of 0 and a net of perhaps $4,000 apiece eir year's earnings.

ecking individual homesteaders, we d that the above estimates from in-

John S. Wynn, above. At right—Klamath homes: (1) George A. Douglass, Jr.; (2) Shirley A. Congdon; (3) Paul E. Christie; (4) Walter M. Hulse; (5) Robert G. Stoerbeck's machinery shed (6) Walter E. Johnson's barn and machinery shed, and (7) James G. Stearns' home.

complete crop returns, couldn't be too far wrong.

We found long, lean Jack Mace, once a gunnery officer aboard a destroyer in the Pacific, scrambling with a sailor's nimbleness up and down the sides of a pile of baled alfalfa hay that looked a city block long and five stories high. He shouted down to us that this was part of 500 tons he had taken off some 110 acres (he has one of the larger farms on the sod lands near the edge of the homestead area) and that most of it had brought about $25 a ton. Next year and the year after he "intends to do some better" by putting the land into barley and then leveling it completely enough to handle anything.

Mace reported that neighbor Bill Crawford, Signal Corps ETO veteran, had already taken 18 tons of seed off 93 acres of clover that were growing when he got the place. The price was reported as 40 cents a pound (that amounts to a total return of $14,400) and the crop had not yet been completely harvested. Crawford also had 16 acres of barley.

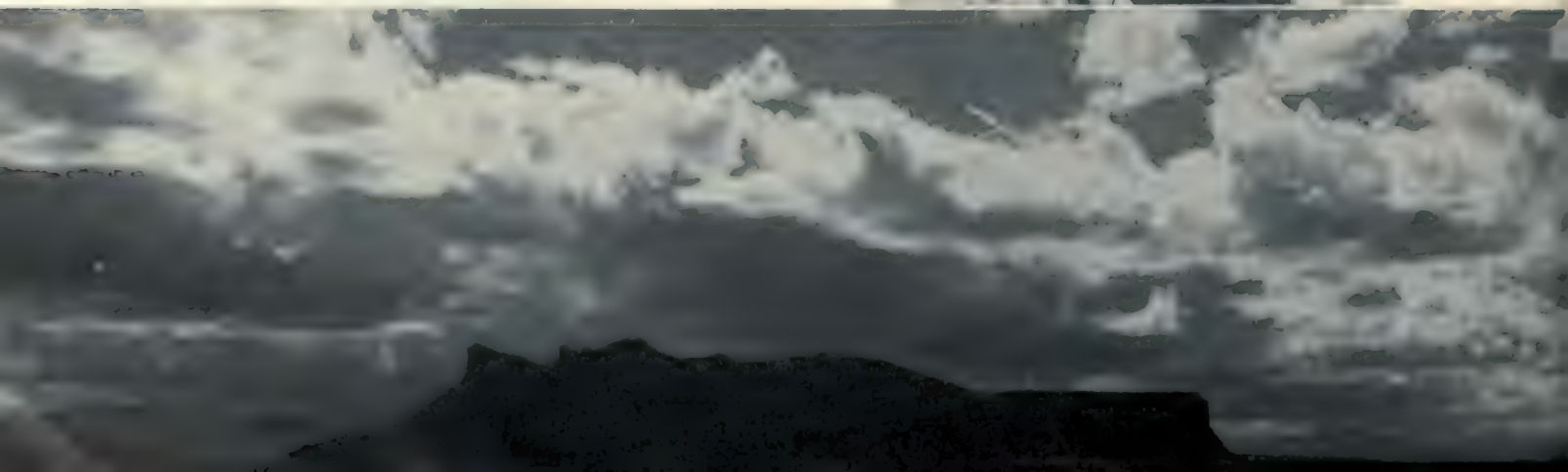
It was some satisfaction to an old GI to find the ex-Colonel Irvings living in a barracks just like anyone else. John Irving was not at home. But his wife, as we took her picture reading a copy of *The Reserve Officer* by the picture window that looked out on the lovely view of the peninsula you see at the bottom of page 32, told us the story of their year's operations. Being mellow enough by now not to wish even the brass any hard luck, we were glad to note that they had taken better than 1,700 sacks of barley off 74 acres. They're going into clover next year.

We approached the Bolesta farmstead with some trepidation. The Bolestas had to succeed. *To begin with, it was ex-Wave*

Eleanor Jane Bolesta (see November 1947 ERA cover) *who won the farm. She is undoubtedly the only woman veteran homesteader in history* (unless George Washington gave Molly Pitcher a land grant). *Husband Charles Bolesta is a fine looking ex-Marine, invalided out of the service after being badly shot up about the legs on Guam. He was born and raised in a big city and never saw a farm until he met and fell in love with farmer's daughter Eleanor while he was doing guard duty on Whidby Island, Wash., before he went overseas.*

Well, we were more than satisfied. Charles Bolesta was looking fine, although the strain of farm work on his legs had laid him up for 6 weeks during the summer. He was feeling fine, too. "Got about 2,000 sacks of barley off 104 dry-farmed acres," he bragged. "Seven acres of clover seed to come in yet. Got 28 sacks off land that I plowed, 18–22 sacks off that I just tilled. I think I'll make a farmer yet." He probably will. While we were there a couple of

Top left, Jack C. Mace on the "house of hay;" immediately under is a field of barley and to the right the sacked product; above at left, Lee S. McMullen; at right, Big Jim Bell, the happy homesteader; immediate right is George A. Douglass, Jr., and little Edie; below, The Peninsula.



farm-bred neighbors, who had been generous with advice earlier in the year, were asking him questions: Lee McMullen, local Production Credit chief, talks about the Bolestas:

LEE: "I am very proud of them."

US: "Yes, they did real well—and he isn't even a farmer."

LEE: "I beg your pardon—he IS a farmer."

The John Wynns were in the upper brackets. He fought through Europe as a field artillery lieutenant, and was discharged just in time to put in an application blank for last year's opening. He leased his 74-acre place for $4,300 and went in with ex-County Agent Ernest Lindsay and Vernon McVey on a lease-land deal that had grossed the three of them $25,000 with 90 percent of the crop in. We didn't see Lindsay and McVey, but they probably did even better than Wynn. Lindsay had 83 acres of his own place in 28-sack-an-acre barley, which should have grossed him $11,000, 14 acres of potatoes for another $5,000–$8,000, depending on the type, and 2 acres of oats. McVey had 45 acres of barley and 29 of clover.

Obviously, nobody starved. Even Jim Stearns, who had gloomed to us about his fatal conservatism, analyzed his income for the year from the place as "56 acres rented at $60—$3,360; 8 in 28-sack barley—$1,120; 8 in seed rye—$945; total—$5,425." He made some more running a few cattle up at his dad's place near La-Pine, Oreg.; worked out some; but drew only 2 months' checks under the GI bill.

For a first year, there has never been a homestead tract as successful as this one.

But, on the other hand, there has never been an inflation like this one, either. So when you ask wistfully, "What did the homesteaders do with all that money?" we come right back at you with "What did you do with all your dough during calendar year 1947?"

Like *you*, the homesteaders spent it, of course:

- on food, averaging better than $100 per month per family. For grub is never cheap in a new country with no competition among corner groceries and supermarkets and no time yet to put in a garden.
- on moving their barracks to the farm and making them weathertight—perhaps $1,000–$1,500 per farm.
- on gasoline, getting around the wide country.
- on home furnishings.
- on tractors and tools.

Most families ended up with not much left, needing production credit loans for their second year.

But probably the difference between them and you and me is that when they had spent their money they had something to show for it.

Everybody had a roomy, weather-tight house, many nicely finished on the outside with shingles or siding or ¾-inch plywood (see houses in the outside column on p. 31) often finished on the inside, too. Every house that we looked at, no matter what the condition of the outside or inside, had a shining new kitchen, crammed with a washing machine, mixer and all that multiplicity of bright new labor-saving devices available to the modern woman.

The sole exception to this culinary convenience and general shipshapeness was the windy, dust-ridden, unchanged barracks of Frank Sullivan, 23-year-old veteran of countless years in the back end of a B–17 over the ETO. One corner of "chez Sullivan," is shown on page 30. As we gazed around at the masculine surroundings and the new Oldsmobile in the front yard, we sneered enviously, "Why don't you marry you a wife?"

He chortled, "Sorry fellows, don't think I'm mature enough to take on such a responsibility until at least 1955."

A wife might help him settle down. He ***only*** *got 2,072 sacks of barley off 74 acres and when we saw him he was doing* ***nothing*** *but picking up potatoes on his dad's farm all day and* ***then*** *coming home to disk his own acreage to keep it from blowing away. Lee McMullen claims he's the best credit risk in the area: "We've been lending that kid money since he was leading whitefaces three times his height into 4–H shows."*

A few homesteaders have already put up permanent homes. George Douglass, Jr., built the house at the top of the opposite column. It is simply the frame of the barracks with good redwood siding; shingles over the tar paper roof and hardwood flooring over the planks; cut up a bit and rearranged. A contractor estimated $13,000 for one like it, "but not as good because the 2 by 4's in the barrack frame are better seasoned and you can't buy that kind of tar paper any more, so build it yourself." His expenditure for the home has been $1,000 for three carpenters for three weeks plus $4,000 for materials.

On page 30 you see the Harry Hundleys cleaning up the front yard of their concrete-block home and putting up an indirect light. Harry Hundley did a lot of the work himself and figures the total cost around $7,000. John Wynn is shown in the photo on page 31 laying the first courses of pumice blocks for a similar house, which will cost him about the same and which would sell for $18,000.

Were the homesteaders reckless in building right now? Farm-raised, most have acquired some skill with tools. This year was a year when you could plant a field crop and figure on having a good income and time to work on your house.

How about high prices for the other things they bought? Several had purchased $2,500 worth of new furniture and household equipment. They commented, "Sure, this is the wrong time to buy. But when the right time comes to buy, who knows whether we'll have the money to buy anything? And maybe inflation will be worse and taxes higher next year."

One said, "Farming is a way of life. Well, it ought to be a pleasant way. I figure we'll be happier and more secure-feeling and feel we have a bigger stake here if we fix things up just as nice as we can. The home is the important thing out here. It's nearly 10 miles to the bright lights of Tule Lake and 30 into Klamath Falls. Lord knows if we'll even be able to get there on these roads this winter. The sooner we make it as pleasant as possible to live on the place the better."

From this kind of talk; after looking at those shining kitchens and seeing how the houses are planned so their picture windows will frame the wonderful views of Mount Shasta, the Peninsula and the lower ranges which are a "no-extra-cost" feature of the project, it is clear that the new settlers realize the sober truth of the fact—brought out in every study of why people leave homesteads—that the attitude of the homesteader's wife is the one most important factor in making a go of pioneering, other things being equal.

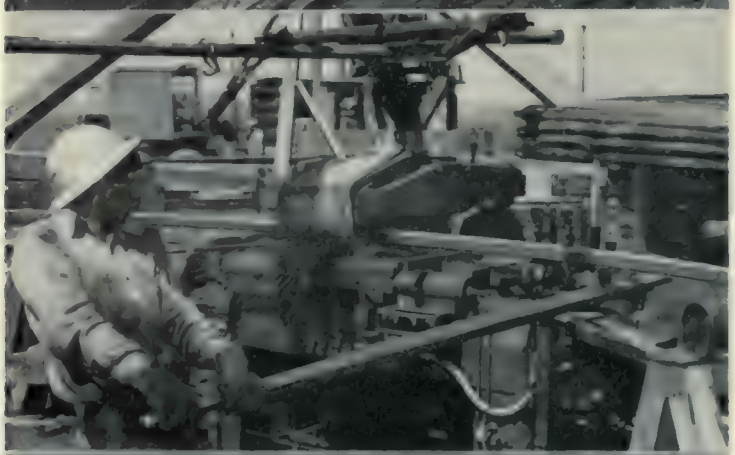
Almost undoubtedly, the "other things" that lead to homesteading success will be equal among this group. The land is good, and the people are already showing the qualities that make successful farmers. We talked about their capacities with Lee McMullen, manager of the Klamath branch of the Production Credit Association, that incredible leading agency, run by the borrowers, which extends credit at infinitesimal interest and still comes out with only a tiny fraction of 1 percent of losses. The PCA has a larger number of homesteader accounts than any other credit agency in the area. McMullen ran over $100,000 worth of loans for them, all paid, cash on the barrelhead, as soon as the crops were sold, against his own figuring that there would be a carryover on 60 percent of the loans for the first 3 years. "The PCA here is in fine shape, and these veterans aren't hurting it at all. We are very happy. Bankers are happy to lend money. But they are even happier to get it back. So the homesteaders make us very happy indeed."

While he admits that this year was kind of a freak, he says, "Even though this was an awfully good year, prices of the things the homesteaders had to buy were very high, and there were lots of things they wanted to buy. Yet the first thing they did with their money was pay their bills. They understand the value of operating on low-cost credit, but they hate debt. That is a very important indication of an attitude that will go a long way toward guaranteeing them success even in normal times, which aren't too bad up here."

Have they bought wisely? Are they overbought on shiny new equipment, which most farmers seem to like to buy for the same reason so many people like to buy shiny new cars? No, he says.

(Continued on page 40)

CONQUERING the COULEES



Today in the Columbia Basin project of eastern Washington, obstacles to construction are being surmounted by ingenious methods, particularly on the West Canal, where contractors have adopted unusual techniques to build the Northwest's biggest siphons.

Midway between Long Lake Dam and Soap Lake, the West Canal leaves elevation 1,320, and drops 100 feet to cross the Dry Coulees in two of the largest siphons constructed for irrigation. Designed to carry 5,100 cubic feet of water (40,000 gallons) per second, sufficient for 300,000 acres, the combined length of the Dry Coulee Siphons is 5,700 feet—more than 1 mile.

The siphons, as designed by the Bureau of Reclamation, are 25 feet in diameter, reinforced with steel. The Bureau specified that the steel must be welded firmly into rings. It also decreed that the concrete of the siphons be at least 2 feet thick.

When Winston Brothers of Los Angeles and the Utah Construction Co. of San Francisco were awarded the West Canal contract, construction engineers decided that only unusual equipment and unusual methods would solve the problem of building the Dry Coulee siphons. So they ordered special welding equipment and had reusable forms designed to carry out the job of building two gigantic concrete tubes.

The time allowed for construction dictated that the normal construction rate be one 25-foot section of siphon each 24 hours. This meant that during each working day 25 tons of steel, including 54 hoops over 80 feet in circumference and weighing 900 pounds each, had to be cut, bent, welded, and erected; the reusable steel forms had to be moved, set to exact position, and filled with 185 cubic yards of concrete. This speedy routine required special welding equipment and unique form design.

These siphons will be subjected to a maximum head of 100 feet of moving water and therefore must be unusually strong. The reinforced concrete shell has a minimum thickness of 2 feet and it requires 1 ton of reinforcing steel and 7½ cubic yards (two truck loads) of high-quality concrete for every linear foot of siphon. Heavy reinforcement is required, and the steel bars are spaced so closely there is not room for the conventional lap splice where bar lengths are joined. Consequently, specifications called for welding without overlapping.

Steel for the hoops was available in maximum lengths of 50 feet, so each hoop required two pieces. The bars were cut to exact length by a diamond saw and then rolled into half circles in a special bending machine. The half circles were placed on a welding table with one pair of opposing ends in the welding machine. After the first weld was made, the hoop was rotated and the remaining ends welded to form the completed ring. When the crews got the "feel" of the job, they turned out from 75 to 100 of these hoops every 8 hours.

A flash welder was used to fuse the steel. In welding, the ends of the bars were clamped in jaws, leaving a gap of approximately three-eighths inch. The operator moved the jaws closer together until the electricity arced across the gap. The full force of 150 kilovolt-amperes (200 horsepower) flashed away tiny pieces of metal in a shower of hot sparks, while the energy of the arc heated the ends of the bars a dull red. The operator then closed the gap and the temperature increased until the bars were bright red for about one-half inch. The operator forced the bar

Top left, steel-ringed carcass of the Dry Coulee Siphon No. 1 awaiting eighth placement of concrete: Center, shaping reinforcing rings for siphon. Crews can turn out 75–100 hoops daily. Lower left, engineer's "House of Magic," an arch of triumph over construction problems. Nearest camera is U-shaped form. Background shows collapsible inside forms. Top and center photos by A. W. Bauman, bottom photo by H. Wayne Fuller, Region 1.

by Floyd S. Arnold,

Resident Engineer, Columbia Basin Project, Region I, Boise, Idaho

ends together under a pressure of 8,000 pounds per square inch. The current flowing through the closed circuit brought the weld area to a white heat, and the pressure on the jaws forced the metal together with a slight bulge at the weld line. Flashing and welding consumed 1½ inches of bar for each weld.

The cage of reinforcing steel for the siphon, consisting of hoops, segmental bars, and longitudinal bars, was supported on steel rails placed on concrete pedestals in the subgrade. Precast concrete blocks were placed along the outer edges to insure that all steel was above the subgrade. All steel was supported by the hoops without internal bracing, thus permitting free movement of an inner form. When the siphon form was in final position, precast concrete blocks were placed between the reinforcement and the form where necessary to insure full coverage over the reinforcement.

To assure a smooth, tight inner surface in the siphon, the Bureau specified that the concrete in each 25-foot section be placed as a monolith—one piece without construction joints. This eliminated the conventional method of placing an invert, or floor section, first, and completing the barrel by placing concrete in forms supported on this invert.

Contractors solved these problems by designing a movable cantilever beam, locally called a "jumbo," to support the inner form for the concrete. Although the individual sections of the siphon are only 25 feet long, the jumbo is 75 feet long, and extends through three sections of the siphon. Cross beams support a track about 4 feet above the subgrade.

The jumbo is supported in the *middle third only*, by two sets of wheels, which travel on this track. The jumbo in turn supports the two sections of inner forms which hold the concrete in place until it hardens. This mechanism is entirely of steel, and is operated by hydraulic jacks.

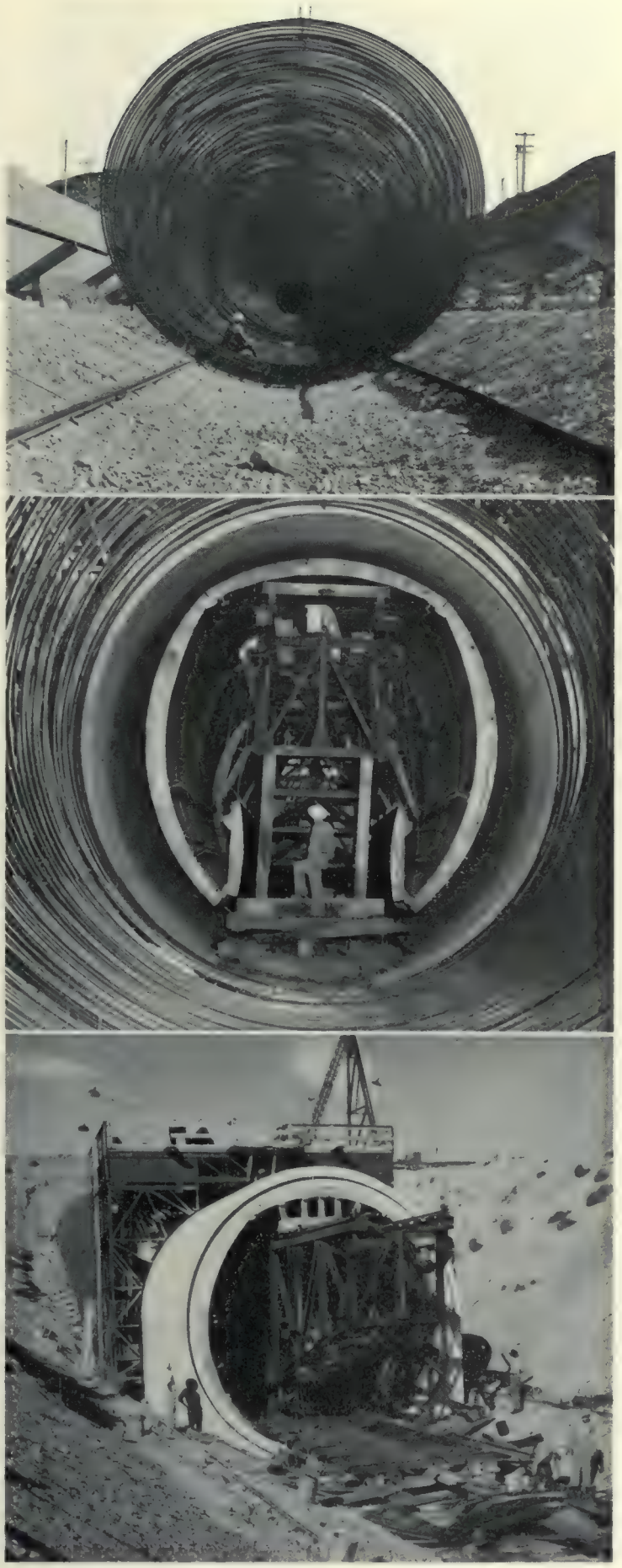
Each 25-foot section of forms weighs approximately 25 tons, and the jumbo alone weighs 20 tons. The total weight of the concrete supported by the inner forms during the hardening exceeds an additional 100 tons.

In operation, the center of the jumbo is placed in a completed section of the siphon. With one inner form wall still in position, the jumbo is supported by concrete previously placed, and extends a full section on each end. A second, or inner form, is collapsed and moved along the jumbo on a carriage through the leading form and into the next section. This inner form is then expanded into position, and concrete is placed between it and the outer form. Again the jumbo is moved forward, and an inner form collapsed, moved ahead, and expanded in position.

The jumbo always rests in a completed section of the siphon, and supports an inner form by cantilever action during concrete placing. The counterforce is supplied by the weight of concrete previously placed around the trailing form. This cantilever action has the distinct advantage of eliminating the use of temporary supports for the inner form.

The outer form is much simpler in design and operation. It appears as a giant, inverted U and travels on rails constructed on each side of the siphon. The walls of the outer form are moved into position opposite an inner form section, and the space between them is filled with concrete. Concrete hardens in 12 hours or more. The outer wall is then loosened by expanding its sides, and it is moved ahead to the next position. A deck over the gantry which

(Continued on Inside Back Cover)



Top right, steel web of enormous hoops shows siphon in formative stage. Center, trailing inner form of siphon in collapsed position, ready to be moved ahead for placing additional concrete. Lower, reusable forms moved into position for placing of concrete. One form inside remains to hold freshly poured concrete. Top and center photos by Harold E. Foss, and lower photo by F. B. Pomeroy, Region I.

River Control by *RADIO*

by Rolland F. Kaser

ROLLAND F. KASER, the author, is Acting Chief of the Division of Operational Control, Office of River Control, Region III, Boulder City, Nev. In this capacity he has charge of dispatching the water of the lower Colorado River as required to satisfy

(1) diversion requirements for irrigation and domestic uses;
(2) requirements for power production at the several power plants, and
(3) flood-control requirements.

Close control of the lower Colorado River is simplified by communication through the radio network shown. Region III photo. →

Let us go back to Labor Day, September 4, 1939, and imagine that you are the reservoir superintendent at Parker Dam. You and your assistant are the only occupants of the Government camp built for operating personnel. All other residents of the camp have taken advantage of the long weekend caused by the Monday holiday and have journeyed to Phoenix and other distant populated places. Such a complete exodus can be understood when it is explained that the camp is at the end of the road, 16 miles from the nearest railroad station and motion-picture theater and 77 miles from the nearest bank.

Monday

Rain has been falling since Sunday night and at noon there is no indication of the end of the storm. Although Havasu Lake is low enough and can store an additional 200,000 acre-feet of water, you decide to begin taking hourly readings of the reservoir gage, so you will know when flood waters begin to reach the lake.

Tuesday

At 2 a. m. Tuesday morning you note that the lake has begun to rise and by 4 a. m., you figure that inflow is 15,000 second-feet. The heavy rain is continuing and you decide to call Lee Dana, water master at Hoover Dam, and ask him to reduce his rate of water release to the minimum for power requirements. Mr. Dana agrees to make the reduction at once and before you have finished your conversation with him the telephone line goes dead, cutting you off completely from the outside world.

Throughout Tuesday, September 5, the rain continues and between 10 and 11 p. m. it reaches cloudburst proportions, so severe that the reservoir gage cannot be read 60 feet away with the aid of a 1,000-candle-power floodlight. The roar of the water racing down the canyons into the lake and river immediately above and below the dam can plainly be heard above the noise of the 11,300 second-feet passing under the spillway gates.

What should you do! You know for sure that a bad flood, possibly larger than the one of February 1937 which is still fresh in your memory, is at hand. Your orders are that all instructions for changing the rate of release from Parker Dam will come from the chief engineer, over 1,000 miles away in Denver, Colo., and you have no way of contacting him or of receiving any message he might be trying to send to you.

Any action you might take yourself could well be disastrous to the safety of the dam and to life and property along the river downstream.

If you continue the present rate of release the dam could very easily be overtopped, with possible catastrophic results.

If you increase the rate of release you might be adding to flood flows which, for all you know, are occurring along the lower river from heavy rains on the lower tributaries, thus causing or increasing heavy flood damage.

The preceding account relates the actual experience of Boyd E. Coffey, reservoir superintendent at Parker Dam. In such a predicament, Mr. Coffey recalled his experience during World War I as a radio technician in the Army Signal Corps. If only he had a radio set to use to contact the outside world!

Wednesday

Suddenly, on Wednesday morning Mr. Coffey remembered that one of the employees of the Metropolitan Water District, who lived in the Gene Camp about 2 miles from Parker Dam, had told him a month or so earlier that he had ordered a shortwave radio transmitter and receiver.

Rushing to the Gene Camp, he found the man and was told that the set was all ready to go but no antenna had been built. Working in the rain, they strung an antenna between two houses and turned on the set. Glory be, it worked! At 11:40 a. m. Wednesday, they contacted a "ham" in San Francisco who managed to contact an acquaintance (also by radio) in Denver.

Using the San Francisco operator as a relay, Mr. Coffey gave the Denver operator a message to the chief engineer, which he delivered by telephone. In this message the chief engineer was informed of the urgency of the situation and the necessity of arranging for expert assistance in deciding upon operation of Parker Dam.

You can well imagine Mr. Coffey's relief in knowing that his message had been delivered and that, by some means, advice and instructions would be on the way.

Thursday

At 1:30 a. m. before dawn on Thursday, September 7, Mr. Coffey determined that inflow to Havasu Lake had reached a peak of about 146,000 second-feet and if inflow continued at that rate the lake would be filled in about 6 hours.

(*Continued on page 40*)

Converted Rice

by GARFORD WILKINSON
Amarillo, Tex.
Region V

Photo courtesy Albert Gommi, Rio Reamy Studios, N. Y

Fit for a King. ***One of many eye and taste appealing dishes prepared with a rice base. This one features sweet and pungent chicken livers.***

Now you can enjoy white, fluffy rice containing the natural vitamins, minerals, and proteins supplied by nature.

This cereal, known as converted rice, is processed from the raw state, still packed with nutritive requirements. The milling operation does not harm its appearance or food value. Delectable as a cookbook picture, it is certain to be popular with America's vitamin-conscious home makers.

Developed in the early years of the recent war, the high food value product was manufactured exclusively for the armed forces until demobilization. Only recently has it become available to the Nation's retail trade.

Events leading to the discovery of the manufacturing process have all the elements of a drama: conflict, human ingenuity, disappointment, perseverance, success!

Houston, Tex., geographical center of the State's rice-growing section, and a chemical food laboratory in far-away England, are the two locales for this drama. Beriberi, the disease resulting from an unbalanced diet, especially common among those who subsist largely on old-fashioned polished rice, is the villain. Two men, a half-world apart and unknown to each other, are the principal characters. Meet the stars—Gordon Harwell, a Texas food broker, and Eric Huzenlaug, an English food chemist.

The time—the late 1930's.

Young, handsome, personable Harwell became interested in rice. He was alarmed by what he learned. Polished rice was good to look at, good to eat, but the outer layers, where nature stores so much of the food value, were being stripped. The product was being robbed of its maximum usefulness.

Harwell became imbued with the idea that in some way nature's store of vitamin's, minerals, and proteins could be preserved by a process of manufacture that would not harm the eye and taste appeal of the rice. The Texan invested $10 in a pressure cooker, a quantity of field-ripened rice, and went to work.

Day after day, night after night, Harwell boiled rice. He soon became one of the best customers the area's rice dealers had encountered up to that time. If placed end to end the grains of rice that he boiled and threw away would reach from here to there. He made some progress. The goal was less distant.

But now, just as they do it in novels and in the cinema, we'll "cut" to Huzenlaub in his laboratory in England, where the food chemist and his coworkers have been laboring for more than 10 years on an identical problem—a manufacturing process that would result in an edible rice, and still retain the essential nutritive elements.

Back to Harwell in Houston. The Lone Star State entrepreneur gets a whiff of news about the successful experiments of the English food chemist. Harwell dashes off a letter to England. According to custom, the letter arrives. Huzenlaub, the British researcher, opens the letter, reads it and—

Huzenlaub isn't interested—his dream, his work, his successful tests have been undertaken for the salvation of millions of persons who eat rice—the populations of India, China, Japan, South America. Americans are not rice eaters; not to any appreciable extent. Fact is, Americans consume less than 6 pounds per capita annually as compared to a pound and a half daily in other parts of the world. What help could be given by this stranger in Houston, Texas?

The Britisher threw the American's letter on a pile of wasted rice and proceeded with his plans to impress the world's largest millers with his new discovery.

But this Texan was a persistent character. He continued writing to Huzenlaub, even though the letters remained unanswered. Eventually, the letters were augmented by cables and telephone calls. The men discussed their experiments, but Huzenlaub definitely was not inclined to enter into any business transaction with Harwell.

Then one day Huzenlaub sailed for this country. He hoped to interest some of the larger American rice millers in his process. When Harwell learned that Huzenlaub had left England for the United States, the Texan went East and met the British scientist when his boat docked. Huzenlaub was courteous. He and Harwell became good friends but the Britisher remained unyielding to the American's proposition of a partnership for the manufacture of the fortified cereal.

The world was at war. "Food for Freedom" was the slogan. American millers were engaged in a world struggle for production. They had no time for experiments or innovations. Food and more food. That was the important thing, Huzenlaub was told.

This was the culmination of more than a decade of life devoted to a successful enterprise that would have meant so much to so many. Disillusioned, dejected, his spirit broken, Huzenlaub prepared to return to war-stricken England.

Through all the weeks that Huzenlaub remained in this country, traveling from city to city, discussing his new food product with manufacturers, receiving negative replies to every plea, Harwell, the friendly, percipient Texan, remained close to the Englishman's side.

Time came for Huzenlaub to board an England-bound plane. Harwell would accompany him to the airport. There he would say good-bye to the Englishman—sever the last thread of hope that the two of them might join forces to improve the basic diet for millions of the world's inhabitants.

Then it happened! Cast aside the story

Left, checking converted rice in the "lab." Above, home of Converted Rice, Inc., Houston, Tex. Photos by Dale Hovey, former Region V photographer.

books with their fictionalized plots and climaxes. Here's the genuine article!

The departing Britisher was injured by a fall. His American friend took him to a hospital and there, during the period of Huzenlaub's recovery, the two men struck a deal.

Men and machines, food, fiber, and metals were scarce items in those days. Harwell and Huzenlaub, striving desperately to begin the manufacture of their new food product, were enmeshed in the struggle for War Production Board priorities, the prerequisite for tools, machinery, plant space.

Armed with reports by noted American chemists showing that this process for rice manufacture retained most of the natural food values, Harwell eventually clinched a few precious priorities. He was spurred on as never before when the research director of the Quartermaster Corps called the Huzenlaub discovery "one of the most significant scientific developments" of the Second World War.

Harwell and Huzenlaub became familiar figures around southwestern junk yards. They picked up boilers, pressure tanks, odds and ends of various machine parts. These were rushed to Houston and assembled in an old, dilapidated warehouse. In this ludicrous setting a marketable supply of polished rice—polished but still a complete food—was manufactured for the first time.

For ages rice has been the staple food for many millions of the earth's inhabitants. It may not be mentioned in the Bible, but its culture is alluded to in the Talmud and there is proof of its culture in the Euphrates Valley and in Syria hundreds of years before the birth of Christ. It is estimated that half of the people in the world now subsist chiefly on rice. As originally prepared by a great majority of persons in those countries where rice is the staple diet, most of the essential dietary elements were retained, but when the millers, in response to demand, removed the outer layers of the grain and polished it to make it more attractive and tasteful, the health of the consumers was affected. They starved, though their stomachs were full.

The process discovered by Huzenlaub, and brought into the trade with the help of Harwell, eliminated the need to rob the grain of its essentials while making it savory and pleasing to the eye.

This secret process involves cleaning the natural grain, placing it in vacuum tanks that suck the air from the kernels and then permeating the required food elements originally contained in the outer husk and bran into the kernels.

The finished product has a sunny color. Strangely, however, the easy-to-cook cereal is fluffy white, after cooking, delicious to the taste and it lacks a gooey substance common with some ordinary rice.

Another important feature of this processed rice is its defense against weevils, one of the costliest enemies known to the trade.

After the initial milling in 1942, increased demands for the new kind of rice by the armed forces and the allied food program made it necessary for Harwell and Huzenlaub to move from the warehouse to a modern plant in Houston's expanding industrial section. The plant was equipped with every facility to speed the food to far ends of the earth. A laboratory, staffed with skilled technicians, tested every batch of the important product to be sure that it met the rigid standards established by the processors and their customers. The product then was packed in waterproof containers which could be, if necessary, floated to shore in distant, embattled areas.

Today, this same company that processes and markets the food product for retail in this and foreign countries under its own trade name is continuing to expand in a new home—one of America's finest and cleanest food plants. Harwell, now president of the concern, and Huzenlaub, who lives in Chicago, where he is continuing laboratory experiments, say that the same method used to process rice from its raw state to an edible, vitamin-packaged product, can be applied to most all other cereals, and even grits, a vitamin-deficient food common to the southern United States.

This relatively new processing method for rice is benefiting growers as well as consumers. Heretofore, farmers often lost a great deal of money by rains at harvest time, which necessitated field shocking. The converted rice company is generally able to purchase the grain just as it comes from the combine in the field, eliminating drying and storage.

Moreover, this new technique for a very old food is certain to increase its consumption in the United States and other parts of the world where it never gained more than a country-cousin welcome.

Another gigantic development that can augment the production of rice and the earnings for growers in the Texas Gulf Coastal Plains region is being investigated by the Bureau of Reclamation. Texas rice growers, along with other farmers and livestock producers, are plagued by the lack of a comprehensive, efficient, economical drainage system for the several million acres of potentially high production land.

The Bureau's investigations, which now are being compiled in report form, will help to design a basic pattern that may be used to reclaim vast areas in the region of which Houston is the principal city.

Although requiring great quantities of irrigation water for the seeding and growing seasons, rice lands must be drained as quickly as possible just before harvest. Where drainage is inadequate, much of the ripened grain shatters and is lost in the soil while farmers remain unable to use their heavy combines. A properly constructed drainage system would solve this problem.

Thus, at a time when a new process for milling rice increases a demand for crop production, when the whole world remains at bayonet point for the lack of food, the Federal Government, through the Bureau of Reclamation and other agencies cooperating with the growers, may soon help to increase and keep production abreast of demand. •

Next Month's FEATURES

SILT — Despoiler of the Soil — by Assistant Commissioner Wesley R. Nelson.

LING FISHING on Ocean Lake by H. P. Vogt, Safety Inspector, Riverton project, Wyoming.

GRAPE Production by Frank D. Maupin, Kennewick, Wash.

Attention: Would-Be Homesteaders!

The table below lists proposed public land openings to be held by the Bureau of Reclamation during 1948. All dates are tentative and dependent upon the availability of funds and personnel. For information on the Shoshone, Heart Mountain, and Riverton openings write to the Regional Director, Bureau of Reclamation, Billings, Mont.; for Klamath, write to the Regional Director, Bureau of Reclamation, Sacramento, Calif.; for Boise, Minidoka, and Yakima write to the Regional Director, Bureau of Reclamation, Boise, Idaho.

Project	Date of opening	Acres	Farm units
Shoshone Project, Heart Mountain Division, Wyoming.	Summer of 1948.	21,700	217
Riverton Project, Wyoming.	Fall of 1948.	9,000	90
Klamath Project, Tule Lake Division, California—Oregon.	Fall of 1948.	6,000	60
Minidoka Project, Gooding Division, Idaho.	Spring of 1948.	4,500	45
Boise Project, Payette Division, Idaho.	Spring of 1948.	7,000	70
Yakima Project, Roza Division, Washington.	Fall of 1948.	700	15
Total.....	.....	48,900	497

Work Speeded on Missouri Basin

December 22, 1947, marked the third anniversary of the Missouri River Basin project, and found the Bureau of Reclamation planning to place the sixth major dam and reservoir under construction. Preconstruction engineering had advanced on nine other dams to the point where all should be under construction this spring. In addition, preconstruction work on four other dams advanced to the point where actual construction probably can begin early in the 1949 fiscal year if funds are provided.

By July 1947 when Congress issued a mandate ordering construction to be stepped up on the Missouri Basin project, contracts had already been awarded for the construction of three dams; Kortes, Wyo., April 1946; Angostura, S. Dak., July 1946, and Enders, Nebr., November 1946. Subsequent to the mandate, contracts were awarded for the construction of Boysen Dam, Wyo., in August 1947, and Heart Butte, N. Dak., in December 1947, and bids were opened at Indianola, Nebr. in late December for the construction of Medicine Creek Dam in Nebraska.

Preconstruction work is underway at Canyon Ferry Dam in Montana. At the same time, investigational and other preliminary work is proceeding on both gravity and pumping irrigation systems, and hydroelectric power developments so that reclamation can help fortify America's "bread basket" for the critical years ahead in the world food situation. Work on several Yellowstone River pumping units has advanced toward start of construction.

The rate of progress attained in the Missouri River Basin since last July 1947 is expected to bring irrigation water to the first acres as fast as construction, financial and economic condition will permit. The project as a whole will bring water to 5,560,000 acres of farm lands having rainfall that is inadequate or unreliable for sustained, profitable crop production.

The Missouri Basin program was approved as a coordinated development by the Bureau of Reclamation and the Corps of Engineers, with the latter agency responsible for extensive flood control and navigation improvements on the main stem, and the construction of certain hydroelectric power plants in connection with these improvements. The Bureau of Reclamation is charged with the irrigation and hydroelectric power developments on tributary areas where for the most part rainfall is insufficient for sustained agriculture, and to bring the corollary benefits of reclamation development, such as municipal water supplies, fish and wildlife, recreation, and flood and silt control.

The hydroelectric power output in the Basin, including that of installations at Army-built dams whose power will be marketed by the Bureau, will be increased by 23 plants having a total 2,000,000-kilowatt capacity in the ultimate development to provide urgently needed power for agricultural uses and to develop mineral, metal, and manufacturing industrial resources. The Missouri Basin project has now obligated approximately 62 percent of the funds available for the 1948 fiscal year.

Bureau's 1948 Appropriations Highest Ever

On December 23, 1947, when President Truman signed the third Supplemental Appropriation Act for the fiscal year of 1948, carrying an item of $32,011,000 for advancing construction on five Bureau of Reclamation projects, the total appropriations for Reclamation were brought to the highest point in any one fiscal year.

The total funds granted the Bureau of Reclamation for the fiscal year of 1948 now total $136,644,738 including authorizations from power revenues, or 13 percent greater than in 1946 the previous high year. Included in the 1948 total are $98,133,738 in the regular appropriation, $6,500,000 in the second supplemental, $6,400,000 of which was for work on the Missouri Basin project, and $100,000 for Yuma, and the third supplemental of $32,011,000.

The last named amount was granted for the continuation of construction on the following projects:

Columbia Basin project, Wash., $13,584,000.
Central Valley project, Calif., $11,405,000.
Colorado Big-Thompson project, Colo., $4,150,000.
Davis Dam project, Ariz.-Nev., $2,800,000.
Deschutes project, Oreg., Arnold Irrigation District (rehabilitation), $72,000.

Bureau Publication "Control of Weeds on Irrigation Systems" to be Revised.

The publication "Control of Weeds on Irrigation Systems" distributed in preliminary form in July 1946 by the Bureau of Reclamation is being revised and is scheduled to be printed early this year. It was the first book of its kind ever to be published.

The mimeographed edition was designed to serve two purposes. The first was to compile and publish as soon as possible such information as was then available so that if desired it could be put into practice by irrigation districts at an early date. Second, it was to serve as a preliminary copy for review by all interested in the subject so that they might give their comments and suggestions for additions and revisions.

According to the responses received it has served both of the purposes well. Many comments have been received regarding the aid it has given irrigation projects.

Numerous suggestions for the revision of the book have been received from Federal agencies, State agricultural colleges, irrigation districts, and many other sources. These suggestions together with new developments which have been made as a result of the weed control research program being conducted cooperatively by the Bureau of Reclamation of the United States Department of the Interior and the Bureau of Plant Industry, Soils and Agricultural Engineering of the United States Depart-

(Continued on next page)

WEEDS (Continued from page 39)

ment of Agriculture will be included in the new edition.

The Bureau of Reclamation is very desirous of making the publication as complete as possible. The information which has been assembled has come from observations made by Bureau officials, through research and from contributions. However, there is no doubt but that many irrigation districts have developed other methods of weed control on their distribution and drainage systems which have proven more economical than methods which are generally known. If possible such information should also be included in the revised edition of the publication. If you know of some labor, time and money saving device or method for controlling weeds on irrigation systems, please forward your suggestion to the Commissioner, Bureau of Reclamation, Washington 25, D. C. Full credit will be given to any such contributions that are used. ●

KLAMATH

(Continued from page 33)

They probably haven't bought quite enough yet. They seem to be doing it right—one man buying one thing, another man another and using the equipment cooperatively on a rational basis for the area, balancing the size of the homesteads against the short seasons, and having about one complete set of equipment for each three farms. The general settler financial status now, he thinks, is that most people have paid all their expenses, have most of the necessary equipment, a good deal of the furnishings for their houses, and are squared away, ready for a smaller amount of loans next year, with the prospect of farm prices just about what they were this year. "Give them one more good year and the whole bunch will be fixed for life!"

The veterans themselves were sure that they would live happily ever after with another good year or two; but they were confident they could make a long time go of the project in any case. They didn't even seem to be too much concerned whether they made a fortune out of their places or not. It was the home that counted.

One couple in their thirties had adopted a fine-looking blonde kid just under two because, as they said, "We felt a home like this needs a little boy running around."

Jim Bell, the big laughing man close on 50 whose picture you see inset on page 32, was buoyant about the whole deal after selling a 2,500-sack crop of premium barley. *He even approved of the Bureau, stating "Everybody says for a Government outfit it's the best outfit we ever dealt with."*

But George Douglass, Jr., the smiling fellow featured on the front cover and page 32, was the man who summed it up best for all the homesteaders. George sailed in a navy gun crew "on every ocean in the world for over 3 years and now I'm in my home port for the first time and home for good. I wouldn't take a million dollars for it. I feel like all the rest of the homesteaders: *this is my home!*"

River Control by Radio

(Continued from page 36)

Still no word had come from the chief engineer, so he tried the telephone again and managed to get a call through to John K. Rohrer, assistant construction engineer, at Yuma, Ariz. He then found that the chief engineer, realizing that he had insufficient information in Denver to give detailed instruction for operation of the gates of Parker Dam, had authorized Mr. Rohrer, by an exchange of telegrams, to issue such instructions and to send an assistant by airplane to Parker Dam.

A telegram had been sent by Mr. Rohrer the previous afternoon but it had not yet been delivered to Mr. Coffey. Accordingly, Mr. Rohrer instructed Mr. Coffey to begin increasing Parker Dam releases at the rate of 6,000 second-feet per hour.

By 7:30 a. m. the total release was about 49,000 second-feet, and was held constant at that rate. T. A. Clark, office engineer, All-American Canal project, arrived at Parker Dam by airplane at 10:30 a. m., Thursday, in time to observe the reservoir peak and to give assistance and advice during the remainder of the flood. His presence was greatly appreciated by Mr. Coffey and his assistant as they had been on constant duty since Sunday night and were practically at the point of exhaustion.

This dramatically illustrates the difficulties encountered by local operating personnel when they are dependent entirely upon telephonic or telegraphic instructions from distant higher authority. Break-downs of such systems invariably occur just when ability to secure a good connection is of utmost importance. In the case cited, Mr. Coffey's telephone connection with Hoover Dam and other outside points was interrupted for almost 3 days during the worst part of the flood. Telegraph communication was also worthless as shown by the fact that the assistant construction engineer at Yuma sent a telegram to Parker Dam on Wednesday, September 6, and it was received 24 hours later, after the flood peak had passed.

Availability of the private short-wave radio set was the factor which saved the day for life and property along the river below Parker Dam.

In 1946 a radio network became essential in order to justify holding the operating level of Havasu Lake higher than had been originally planned, thereby increasing power production at Parker power plant from the limited water supply, in order to partially alleviate the severe power shortage in central Arizona.

The Office of River Control, the recently organized regional office charged with the responsibility of dispatching the water of the lower Colorado River, made studies which showed that some increase over the levels used during the war, could be allowed if an efficient flood-warning system was installed.

The radio stations, located at strategic points in the Bill Williams River basin in Arizona, would provide the basic data needed for such a warning system. This information (including precipitation, stream stage, and other hydrologic data) would be analyzed by hydrologists and meteorologists of the Office of River Control, together with all available meteorological data (raobs, pibals, etc.) and forecasts received from the Weather Bureau, who would then be able to make plans for scheduling releases from Hoover and Parker Dams to control possible flood run-off.

Two-way radio stations were installed during the fall of 1946 at Wikieup, Bagdad, and Ritter's Ranch near Yava, Ariz. Since their installation these stations, using surplus Navy equipment modified by Parker Dam forces, have been in daily contact with each other and with a private station installed at Parker Dam by Boyd Coffey. A frequency of 2,822 kilocycles has been used exclusively thus far; however, authorization to use a frequency of 5,287.5 kilocycles during daylight hours has been obtained and tests indicate that this latter frequency may prove better during the summer months.

Operation of these "pioneer" stations has amply demonstrated the practicability of using radio communication and the desirability of completing the network.

A 100-watt station was placed in operation early in November of this year in the quarters of the Office of River Control in Boulder City and another went into operation in the River Control office at Needles, Calif., shortly thereafter.

An additional station will be added by the Parker Dam power project at Parker Dam in the near future. This last station will be used for water and power dispatching and for contact with line maintenance crews in addition to transmission of flood warning information, while the Boulder City and Needles station will also be used for communications in connection with river channel construction activities.

As a result of installation of the radio network, we can now be sure that Mr. Coffey's experiences during the September 1939 flood will not be repeated during future floods.

In addition, officials responsible for dispatching the water of the river will have complete up-to-the-minute information on storm and run-off conditions as they occur and will be able to modify their plans to accommodate changing conditions, since they will be able to predict future inflow within reasonable limits about 12 hours before the inflow reaches Havasu Lake. ●

NOTES FOR CONTRACTORS

Contracts Awarded During December 1947

Specification No.	Project and State	Award date	Description of work or material	Contractor's name and address	Contract amount
1903	Missouri Basin, Wyo	Dec. 12	2 vertical-shaft, 10,500 horsepower hydraulic turbines	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	$258,000.00
1903	do	do	2 governors for 10,500 horsepower turbines	Woodward Governor Co., Rockford, Ill	41,396.00
1903	do	do	2 8,333-kilovolt-ampere generators	Westinghouse Electric Corporation, Denver, Colo.	305,105.00
1910	Davis Dam, Ariz.-Nev	Dec. 26	Construction of Parker-Pilot Knob 161-kilovolt transmission line.	J. & J. Construction Co., Oklahoma City, Okla	1,213,497.62
1918	Boise, Idaho	Dec. 15	7 5,500 kilovolt-ampere transformers	Pennsylvania Transformer Co., Pittsburgh, Pa	162,106.00
1918	do	Dec. 5	2 115,000-volt, outdoor circuit breakers	General Electric Co., Denver	46,047.00
1918	do	Dec. 10	1 115,000 volt, outdoor disconnecting switch	Schwager-Wood Corp., Portland, Oreg	7,661.87
1924	Colorado-Big Thompson, Colorado.	Dec. 17	10 115,000 volt, outdoor circuit breakers	Westinghouse Electric Corp., Denver, Colo	193,256.00
1924	do	Dec. 19	10 6,000-kilovolt-ampere and 4 3,333-kilovolt-ampere transformers for Estes switchyard.	Pennsylvania Transformer Co., Pittsburgh, Pa	319,006.00
1924	do	Dec. 17	18 disconnect switches for Estes switchyard	Electric Power Equipment Corp., Philadelphia, Pa	70,496.64
1932	Davis Dam, Ariz.-Nev	Dec. 29	Steel structures for Phoenix switchyard	Allison Steel Mfg. Co., Phoenix, Ariz	19,254.00
1939	Central Valley, Calif	Dec. 23	6 108-inch butterfly valves	Newport News Shipbuilding & Dry Dock Co. Newport News, Va.	177,000.00
1940	Boise, Idaho	Dec. 9	Control and station service equipment	Westinghouse Electric Corp., Denver, Colo	26,898.00
1940	do	do	Station service unit substation	ITE Circuit Breaker Co., Philadelphia, Pa	27,751.00
1954	Boulder Canyon, Calif	Dec. 4	Construction of dyke No. 1, All-American Canal	Marshall, Haas, and Royce, San Mateo, Calif	879,245.00
1954	do	Dec. 3	Construction of dyke No. 2, All-American Canal	Claude Fisher Co., Ltd., L. S. & R. S. Crow, Los Angeles, Calif.	916,930.00
1970	Missouri Basin, S. Dak	Dec. 5	Embedded anchorages for radial gates	Willamette Iron & Steel Co., Portland, Oreg	27,995.00
1971	Davis Dam, Ariz.-Nev	Dec. 24	Circuit breakers and disconnecting switches	Westinghouse Electric Corp., Denver, Colo	24,402.80
1978	Columbia Basin	do	Resistors	do	11,365.20
1978	do	do	Transformers	Allis-Chalmers Mfg. Co., Denver, Colo	16,832.00
1982	Davis Dam, Ariz.-Nev	Dec. 12	1 24-ton traveling gantry crane	Judson Pacific-Murphy Corp., Emeryville, Calif	33,045.00
1983	Missouri Basin, S. Dak	do	5 50-foot by 50-foot radial gates	Virginia Bridge Co., Denver, Colo	150,000.00
1987	W. C. Austin, Okla	Dec. 15	Construction of Ozark laterals 4.6 and 15.2	Pannell Construction Co., Helena, Mont	288,730.00
1988	Colorado Big Thompson, Colorado.	Dec. 24	Traveling cranes	Judson Pacific-Murphy Corp., Emeryville, Calif	80,100.00
1988	Missouri Basin, Wyo	do	do	do	44,600.00
1992	Missouri Basin, N. Dak	Dec. 3	Construction of Heart Butte Dam and dike and relocation of State Highway No. 49.	C. F. Lytle Co. & Greene Const. Co., Des Moines, Iowa	2,360,743.00
1994	Deschutes, Oreg	Dec. 23	Construction of laterals M–58 and M–61 and sublaterals	Adler Construction Co., Madras, Oreg	414,736.00
2002	Missouri Basin, S. Dak	Dec. 30	Structural steel for Angostura Dam spillway bridge	Virginia Bridge Co., Denver, Colo	20,600.00
2009	Boulder Canyon, Nev	Dec. 23	Construction of pumping plant No. 2–A, Boulder City	Griffith, Gornall and Carman, Inc., Salt Lake City, Utah	31,195.50
2013	Columbia Basin, Wash	Dec. 31	Steel workbarge and revolving crane	American Bridge Co., Denver, Colo	78,000.00
2020	Boulder Canyon, Nev	do	Steel structures for Boulder City substation	do	15,465.00

Construction and supplies for which bids will be invited during February 1948

Project and State	Description of work or material
Boise, Idaho	Hydraulic turbine driven pumping unit for Willow Creek pumping plant.
Boulder Canyon—All-American Canal, Calif	Construction of about 6½ miles of high-pressure concrete pipe laterals for Coachella division.
Central Valley, Calif	15-kilovolt oil circuit breakers and disconnecting switches for Tracy switchyard.
Colorado-Big Thompson, Colo	11-foot discharge pipes for Granby pumping plant.
Columbia Basin, Wash	230-kilovolt, 10,000 kilovolt-amperes oil circuit breakers, 230-kilovolt disconnecting switches for Grand Coulee switchyard.
Do	Unit substations for tail tower, caisson drydock, and caisson puller machines, Grand Coulee power plant.
Do	Extension to 6,900-volt station service switchgear for Grand Coulee power plant.
Davis Dam, Ariz.-Nev	22 by 19-foot radial gates for Davis Dam power plant.
Fort Peck Power, N. Dak	Main control board for Williston substation.
Hungry Horse, Mont	Hydraulic turbines and governors for Hungry Horse power plant.
Do	Generators for Hungry Horse power plant.
Kendrick, Wyo	Construction of approximately 16.5 miles of 34.5-kilovolt transmission line from Medicine Bow to Hanna, Wyo. Wood poles.
Klamath, Calif.-Oreg	Pumping units 4 and 5 for Modoc pumping plant D.
Missouri Basin, Colo	Erection of 12 2-bedroom and 4 3-bedroom prefabricated residences at Narrows Dam Government Camp, near Fort Morgan, Colo.
Missouri Basin, Kans	Construction of Cedar Bluff Dam and earthfill structure on the Smoky Hill River, near Hays, Kans.
Missouri Basin, Wyo.-Neb	Construction of 45 miles of Gering-Alliance, Nebr. and 38 miles of Cheyenne-Pine Bluffs, Wyo., 115 kilovolt transmission lines. Wood poles.
Ogden River, Utah	Construction of equalizing reservoirs No. 13 and No. 17 and pipe-line structures for laterals No. 13–1 and No. 17–1 in South Ogden distribution system.
Provo River, Utah	Construction of steel pipe line and structures for Big Cottonwood section.

CONQUERING THE COULEES (Continued from Page 35)

holds the outer form provides a working platform from which concrete can be placed between the inner and outer forms.

High-quality concrete to protect the reinforcement and contain the irrigation water is necessary for successful operation of the high-head Dry Coulee siphons. Aggregate for the concrete was obtained from a nearby gravel deposit, washed clean, and separated into four sizes—three of rock and one of sand. All were carefully graded as to size and recombined by weight to form dense concrete mixtures: 1 part cement, 2.2 parts sand, and 4.1 parts rock of the maximum size of 1½ inches.

A special cement was used to increase the resistance of the concrete to alkalis, and an air-entraining agent was added to the concrete to increase resistance to weathering and to improve the workability of the mixture, thus insuring both a durable surface and sound concrete consolidated tightly about the reinforcement.

A system of vertical pipes, known as "elephant trunks," was used to carry concrete to proper places in the form. Once in place, the concrete was thoroughly consolidated by air-actuated internal vibrators.

The placing operation required an average of 8 hours for a section—185 cubic yards. After the concrete hardened 12 to 36 hours, the forms were moved, and the surfaces covered with a white pigmented sealing compound. This compound seals all moisture in the concrete and assures proper strength development because the chemical action of hardening continues indefinitely in the presence of water. The sealing compound also reflects the sunlight which, if absorbed, may cause damage to the concrete by creating high surface temperatures. ●

KLAMATH BARLEY—A Study in Perspective

by Ben Glaha, Chief Photographer, Region II

I27.5
Vol. 34
No. 5

H

Featuring:

SILT—*Despoiler* of the Soil

by

Asst. Commissioner

VESLEY R. NELSON

Multiple-Purpose PLOW

RECLAMATION In *AFGHANISTAN*

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Kansas City, Mo.

THE Reclamation ERA

Letters to the Editor

SESTO CALENDE—regulates Lake Maggiore

MILANO VIA PRIVATA MANGILI, 2,
16 December 1947.

DEAR EDITOR: I have received your communication informing me that from May 1946 you have again begun to publish your beautiful magazine RECLAMATION ERA. I was a regular subscriber up to December 1940.

Will you kindly send me all the numbers issued from 1941 and regularly subscribe me for 1948?

During the war I constructed the plan of a great barrage for the regulation of the Lake Maggiore. I was also the director of the works.

I here include a photo of the barrage.

I am now the director of this State corporation. The barrage is actually managed by a State corporation called "Consorzio del Ticino" in Milan, Corso Porta Nuova 18, and I am the general director.

Today by post I have sent you two books of studies we have published during these years and I hope you will accept them.

The next new publication will soon be ready and I will send it to you.

I have also sent you a map scale 1: 500.000 of Lake Maggiore regulation and I hope it will interest you.

With kind regards, yours sincerely.

DR. ING. RICCARDO GRAMIGNA.

Land Speculation

Assistant Secretary of the Interior William E. Warne kindly turned over to the RECLAMATION ERA the following letter from John Haw, believing it to be of interest to our readers.

I read with unusual interest your article in the August issue of the RECLAMATION ERA entitled "Land Speculation." I meant to write complimenting you on presentation of this subject and the manner in which it was done.

Emphasis on the speculation in desert land ahead of construction on Federal projects needs to be called to the attention of water users who are now screaming about construction costs on projects

(Continued on next page)

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Ruth F. Sadler, *Editor*

NEXT MONTH—How natural boundaries are utilized in laying out Columbia Basin farms—a story on topography and irrigation farming by W. W. Johnston, project development supervisor, Columbia Basin project.

***ALSO*—Dr. Schildknecht's report on Switzerland's wartime reclamation program for food production, and an account of underground pipe irrigation in the Yakima Valley.**

Our Front Cover

Sweet Grape Picker

Ellen Honeycutt, Benton City, Oreg., seems to be enjoying her hard work in the grape arbors of the Kennewick Division of the Yakima project in Washington. The box she is holding is known as a "lug." This is carried by the picker until filled, when it is collected by a truck. Ellen picks an average of 35 lugs daily. See "Grapes," page 49. This photo was taken by Stanley Rasmussen, photographer, Boise, Idaho, Region 1.

recently completed or now in work. I hear so often the statement that early project water users had difficulty in meeting construction costs of only $75 or $100 per acre thereby leaping to the assumption that costs of $200 or $250 per acre is certain to ruin those who assume the burden on new expensive projects. Entirely overlooked is the fact that the raw desert land cost these early project water users all the way from $200 to $500 per acre, that unpaid balances on this land purchase price carried at from 6 to 8 percent interest and had to be repaid over a period of 5 to 10 years. This is to say nothing of the larger interest-free repayment period.

Furthermore, and in addition, present debts will undoubtedly be paid with diluted dollars as compared to 20 or 30 years ago. . . . Your article was very well done and well-timed.

Yours sincerely,

JOHN W. HAW,
Director, Agricultural Development Dept., Northern Pacific Railway Co., St. Paul, Minnesota.

From Ohio

MANSFIELD, OHIO,
238 RENNY AVENUE,
December 13, 1947.

DEAR EDITOR: I am more than interested in your good Bureau, and the good work you are doing and intend to do in the future. I enjoy studying your magazine, and would be more than pleased to receive a few of your back numbers. And oblige,

J. C. BOYER.

Un-Busy Beavers

With the kind permission of the United Press we are reprinting the following article datelined St. Helens, Oreg., August 28, 1947:

Two males and a female beaver, recruited to do a dam-building job for this city of 4,000 persons, disappeared today and nobody seemed to know whether they were casing the assignment or solving the eternal triangle.

The beavers were obtained last week from the Oregon State Game Commission and freed alongside Milton Creek, a dwindling source of city water. The city council decided it needed more retaining dams on the creek.

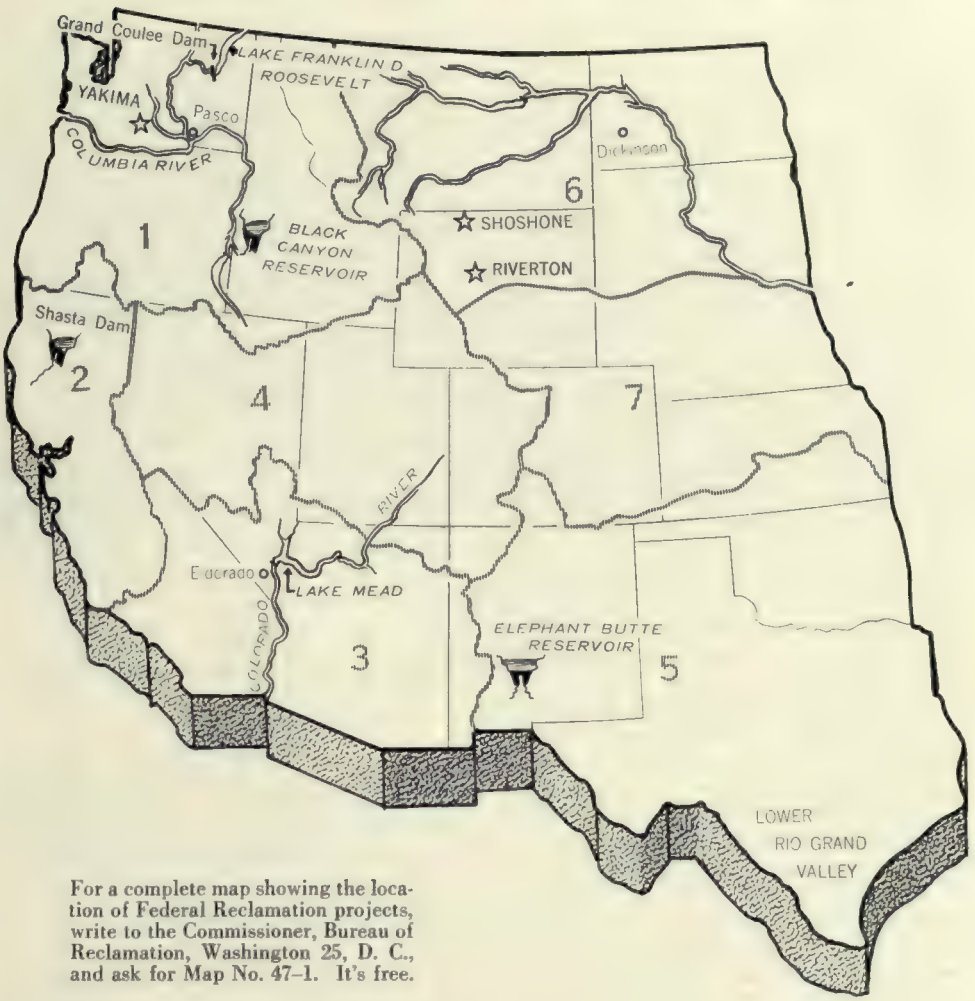
"We just put them in and told them to do what comes naturally," Councilman Ben Coleman explained.

But yesterday the council sent a man out for a progress report. His report indicated something was wrong: "No dams, no beavers."

There was no immediate explanation. Mr. Coleman put it this way:

"We thought that when you put out two he-beavers and one she-beaver, you got a dam. But now I don't know. Maybe you get trouble."

Reclamation Place Names in this Issue



For a complete map showing the location of Federal Reclamation projects, write to the Commissioner, Bureau of Reclamation, Washington 25, D. C., and ask for Map No. 47–1. It's free.

Credit

Photographs which illustrated the "Golden Harvest at Klamath" article in last month's issue were all taken by J. E. Fluharty of Region II.

Name	*Address*

"Get Acquainted" Copies

If you have friends or associates who would be interested in the *Reclamation Era*, please list their names and addresses in the box to the left, clip and send it to the Commissioner, Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues so that they can get acquainted with your magazine.

A Plan for Expanded Food Production

Secretary of Agriculture Anderson in his annual report to the President of the United States for the fiscal year ending June 30, 1947, called for a fivefold increase in range and pasture seeding, in drainage and preparation of land for more efficient irrigation. He said that if we permit our land to deteriorate we cannot maintain our present standard of living, as American agriculture "now finds it has reached the limits, practically speaking, of its land resources," and that "from now on we must live with the resources at hand." He stated that the American people would like to be able to buy one-third more food than they had during the last half of the 1930's.

This statement confirms the findings of the Bureau of Reclamation which last November was requested by Representative Walt Horan of Washington to submit a report on the extent to which Reclamation construction could be speeded up to expand Reclamation farmlands in the West and produce more food to meet domestic and foreign needs.

Subsequently, Assistant Secretary of the Interior William E. Warne and Commissioner of Reclamation Michael W. Straus testified before the Western Subcommittee of the Congressional Joint Committee on the Economic Report on December 17, 1947, and at the request of the chairman of the subcommittee, Senator Watkins of Utah, submitted into the report of the hearings a plan for speeding up construction on certain Reclamation projects in order to accelerate a special-purpose food production program.

In this report, Commissioner Straus stressed the following facts:

- If we are to meet the demands of Europe in addition to those of our own country, extraordinary efforts must be made within a period of time which is comparatively short in relation to the long-range objectives of Reclamation.

- The span of the proposed European recovery program (or Marshall plan) is approximately 4½ years from now, or until June 30, 1952, therefore, Reclamation's participation would be limited to—

(*a*) Projects now under construction, or those which can be placed under construction relatively soon;

(*b*) Projects that can be producing food within the period of the European recovery plan; and

(*c*) Projects which are part of Reclamation's long-term program and whose construction at this time will not throw the entire program out of balance.

Keeping these points in mind, Commissioner Straus stated that an accelerated program on specific irrigation projects would bring some 5,600,000 acres of new lands into production and additional crops totaling over 28,000,000 tons.

On the basis of 1947 prices, this program would cost a little over $1,300,000,000. Although resort to speed-up methods would undoubtedly force up the total cost, much of the addition would be offset by savings in overhead and investment charges so that the increased cost would probably not exceed 25 percent of the normal expected cost of the program.

Following are excerpts from the report submitted to the subcommittee based upon the Bureau's analysis of the subject as requested by Representative Horan.

Acres of Additional Land

The total acreages of land that can be placed in production each year on the selected projects in the Western States (exclusive of Reclamation by drainage in the Gulf States), together with the estimated annual crop yield, and the estimated additional funds required, are as follows:

Fiscal year	Land	Annual crops [1]	Additional funds required
	Acres	*Tons*	
1948	331, 801	792, 000	$53, 707, 054
1949	562, 305	2, 193, 950	384, 344, 586
1950	1, 351, 258	4, 810, 595	401, 095, 706
1951	2, 480, 850	9, 572, 689	339, 781, 239
1952	880, 790	10, 793, 963	187, 854, 136
Total	5, 607, 004	28, 163, 197	1, 366, 782, 721

[1] Estimated production each calendar year corresponding to the fiscal year in which the land is made available.

Each of the projects listed below has been found to be justified on the basis of benefit-cost studies and each is a part of the long-range program of the Bureau. The list is flexible and indicates only those projects on which there is a reasonable certainty the necessary schedule can be met without unusual or extraordinary cost. It does not represent the maximum upper limit of the program.

Additional Food Required

The present food situation, both here and abroad, calls attention to the urgent need for bread grains, consisting of wheat and rye. Other grains, fats and oils, meat, dairy products, and fruits and vegetables will also be required for shipment abroad.

Irrigated land can be depended on to produce large quantities toward meeting the goals for these groups of food products.

In addition to the foodstuffs which will be needed for the foreign aid program, we must maintain the American standard of living for an increasing population. In some sections irrigated land can best be utilized by growing specialty crops for home consumption. This would permit acreages in other sections of the country to be placed in wheat, which is not considered a good irrigated crop, as well as corn, which cannot be grown in large quantities on irrigated land in northern areas where the growing season is short. Total crops, as estimated, include alfalfa and other food and forage crops that are converted into meat, eggs, and dairy products.

Western irrigated areas are important segments of the livestock industry, providing pasture and alfalfa for winter feeding. Development of additional feeding areas means more pounds of meat and butter and more eggs and milk on tables at home and abroad.

The total amount of crops resulting from this accelerated program would be substantial, resulting in a maximum annual figure of over 10 million tons in 1952, a part

(*Continued on page 48*)

TENTATIVE LIST OF PROJECTS INCLUDED IN FOOD PRODUCTION PLAN

Region I

Boise-Anderson Ranch, Idaho.
Boise-Payette, Idaho.
Columbia Basin, Wash.
Deschutes, Oreg.
Lewiston Orchards, Idaho.
Minidoka-Gooding-North Side, Idaho.
Yakima-Roza, Wash.
Council, Idaho.[1]
Vale-Bully Creek, Oreg.[1]
Crooked River, Oreg.[1]
Yakima-Kennewick, Wash.[1]
Upper Star Valley, Wyo.[1]
Rathdrum Prairie-Hayden Lake, Idaho.
The Dalles-West Unit, Oreg.
Baker Upper Unit, Oreg.[1]

Region II

Central Valley, Calif.
Klamath-Tule Lake, Calif.-Oreg.
Kings River, Calif.[1]
Solano County, Calif.[1]

Region III

All-American Canal-Coachella, Calif.
Gila (incl. Wellton-Mohawk), Ariz.
Holbrook-Joseph City, Ariz.[1]

Region IV

Mancos, Colo.
Paonia, Colo.
Provo, Utah.
Newton, Utah.
Preston Bench, Idaho.[1]
Vernal Project, Utah.[1]
Sublette (La Barge), Wyo.[1]
Minnesota, Colo.[1]
La Plata, Colo.
Gooseberry, Utah.[1]

Region V

W. C. Austin, Okla.
Tucumcari, N. Mex.
San Luis Valley, Colo.
Valley Gravity, Tex.
Fort Sumner, N. Mex.[1]
Fort Supply Pumping, Okla.[1]
Canton, Okla.[1]
Vermejo, N. Mex.[1]
Fort Gibson, Okla.[1]
Balmorhea, Tex.[1]
Dry Creek, Tex.
Middle Rio Grande, N. Mex.[1]
Zapata, Tex.[1]
Englewood, Okla.[1]
Miami, N. Mex.[1]
Cotulla, Tex.[1]
Big Creek, Tex.[1]
Blue Water, N. Mex.[1]
Fort Cobb, Okla.
Mountain View, Okla.[1]

Region VI

Riverton, Wyo.

Region VII

Colorado-Big Thompson, Colo.
Kendrick, Wyo.

Missouri River Basin

Angostura, S. Dak.
Belle Fourche, S. Dak.
Big Horn Pumping, Wyo.
Bostwick, Kans.
Boysen, Wyo.
Cannonball, N. Dak.
Cedar Bluff, Nebr.
Clarkston Pumping, Mont.
Edgemont, Wyo.-S. Dak.
Frenchman-Cambridge, Nebr.
Grand River, S. Dak.
Heart River, N. Dak.
Kirwin, Kans.
Lower Marias, Mont.
Montana Pumping, Mont.
North Dakota Pumping, N. Dak.
Owl Creek, Wyo.
Paintrock, Wyo.
Rapid Valley-Pactola, S. Dak.
St. Francis, Colo.-Kans.
Shoshone Extension, Wyo.
South Bench, Mont.
Sun River, Mont.
Tongue River, Wyo.
Wilson, Kans.
Yellowstone Pumping, Mont.-N. Dak.

[1] Unauthorized.
[2] Contingent upon expedition of construction by Army.

View of Jemez dam site, N. Mex. Note cows in background of reservoir area. Photo by Dale A. Hovey, formerly of Region V.

SILT

Despoiler of the Soil

By Wesley R. Nelson

Assistant Commissioner, Bureau of Reclamation

The subject of reservoir sedimentation and its relation to upstream conservation and engineering may be a dry topic but it is a subject which is of vital importance not only because of the direct effects of sedimentation, but by its implications—the destruction of the soil which provides the bread on which we live.

The process of water, picking up the soil, transporting it and redepositing it has been underway since water first appeared on the earth. Without this natural process there would have been no rich deltas, no fruitful valleys, in fact very little soil on which man might live. Man has accelerated the process in many places—in too many places—but in others he has slowed the process to a marked extent.

Far up in a valley of the Rockies a spring bubbles forth from beneath a sandstone ledge. Its waters form a brook which tumbles over the rocks, at the beginning of a journey which may lead perhaps to the sea from which it came. Soon the brook is joined by others, a creek is formed, other creeks join and a river is formed.

The waters leaving the spring are clear, cold, and usually pure. They remain so until disturbed by some untoward event, but that these events do occur is made evident by the appearance of most of our western rivers.

Sediment Rides Again

These waters are spirited extroverts. They are great joiners and they love company. They enjoy taking anything movable along for the bus ride and as long as there is room and a passenger is available, the bus continues to fill. But unlike our modern transportation, the water bus, operated by gravity, must be going somewhere before it will take on a sediment passenger, and the faster the bus travels, the more sediment passengers can climb aboard. In turn, when the sediment-laden bus slows down, some of the passengers must get off.

Unfortunately, the sediment passengers who are going for a ride are carrying off our valuables of prosperity and even life itself; so we had better get a cop out on the bus line and keep the passengers at home.

With this in mind let us follow this allegory a little further and find out why the sediment passenger leaves home. In the first place, he has been a great traveler. Usually, that is how he got where he is today. And although he is willing to stay at home and be a "do-gooder," he loves his old pal water who made him what he is today, and is easily carried away by overenthusiasm. Where practicable, the best way to keep him at home is to give him a job to do—supporting a family of grass, of shrubbery, of trees. In this way he gets tied down and if he still has roving tendencies, his family will sit on him.

With this homely introduction, let's get down to cases. Flowing water has a tendency to pick up sediment whenever the two come in contact. The amount taken into suspension depends on the volume, velocity, and turbulence of the water, the type of soil and the soil covering. Whenever the velocity of a sediment-laden stream is reduced, sediment is deposited, the amount of deposition depending on the amount of silt in suspension, the amount of reduction in velocity, and the quality of the sediment.

Rapidly melting snows and torrential

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storms are the greatest producers of sediment-laden streams. If not halted by barriers, either natural or man-made, the soil is carried into the sea and forever lost to man. Even if deposited in or along the stream the soils usually have been torn apart and are not immediately available for plant production. If the sediments are deposited in a reservoir, the life of this man-made lake is definitely limited and the fish, wildlife, and recreation values are impaired. Practically all of our reservoirs are of a multiple-purpose type. Thus, the loss of reservoir capacity to sedimentation may be felt by irrigation, power, municipal water supply, flood control, recreation, and wildlife. And don't forget that loss of soil from our watersheds means bigger floods. It also means loss of plant life for the support of game and fish.

Tremendous Soil Losses

The loss of soils in the United States from erosion, of which uncontrolled water is a major offender, is estimated to be 500,000 acres per year. The amount of sediment carried by our western rivers is tremendous. The Colorado River at the upper end of Lake Mead carries an average of more than 100,000 acre-feet of sediment annually which is deposited in Lake Mead. Elephant Butte Reservoir in New Mexico lost 17 percent in 31 years; Black Canyon Reservoir in Idaho lost 11 percent in 12 years. These are a few of the more critical examples. Sedimentation has affected all reservoirs in some degree.

Closely associated with reservoir sedimentation is the deposition of sediment in the backwater area immediately above a reservoir pool. In addition to causing possible damage to existing valley improvements by restricting flood channel capacities, a problem of reduced water supply of another nature than actual reduction of storage capacity is caused. This results from a high increase in nonbeneficial consumptive use of water from heavy growths of salt cedars or similar vegetation which generally occur in the delta deposits. At the head of Elephant Butte Reservoir this nonbeneficial consumptive use has been estimated to be in the neighborhood of 150,000 acre-feet per year, which is approximately 13 percent of the average annual flow.

The vegetation in delta areas is not entirely nonbeneficial, however. This vegetation acts as a screen to trap sediment before it enters the reservoir. At Elephant Butte Reservoir, for example, the annual rate of depletion of storage capacity in the reservoir proper has fallen from about 13,000 acre-feet to about 6,000 acre-feet because of vegetation. In addition wildlife interests have found this vegetative area to be an excellent home for various types of wildlife. The fact remains, however, that these advantages have been gained at terrific cost of water, in an area that can ill afford such losses.

The loss of storage through sedimentation deals a blow to the economy of a project area far greater than the initial cost of the reservoir. In the first place it can reasonably be assumed that the dam was constructed at the most favorable location, either in point of initial cost or in operating charges. A new damsite, if available, will have to be a point where either construction costs are higher, or where water conveyance costs are higher. Secondly, continuous loss of reservoirs through sedimentation will mean that all available sites will eventually be used up, since there is generally a definite physical limitation on the number of feasible sites available. Dam sites can therefore be considered a natural resource and must not be used up carelessly, in the same sense that timber resources must not be wantonly depleted, without regard to restoration.

In many reservoirs constructed by the Bureau of Reclamation and by other Federal agencies, provision is made for reservation of a minimum pool to preserve fish and wildlife habitats or for minimum releases from the reservoir to protect downstream fish or wildlife. For these purposes, the problem of siltation is vitally important also, since deposition of sediment in reservoirs immediately begins to encroach upon the minimum pool, and the wildlife habitats along the shores are soon made unusable by the layers of muck deposited. On the other hand, the removal of sediment by the reservoir may have a beneficial effect upon the stream below since the water released is cleansed of all but the finest particles.

The Seventy-ninth Congress recognized the value of reservoirs to fish and wildlife conservation, and passed Public Law 732 which authorizes the Secretary of the Interior, upon finding of the part of the project cost which can properly be allocated to these purposes, to make such an allocation on a nonreimbursable basis. This law, and its provisions for mandatory inter-agency cooperation on investigations, will go far toward insuring adequate consideration of these matters in future project planning. A still more far-reaching piece of legislation is now on the calendars of Congress, however. This bill (H. R. 2873) if passed in its present form, would provide for nonreimbursable allocations of cost not only to fish and wildlife, but also to general salinity control, recreation, and silt control.

"Life Extension" for Reservoirs

It behooves us, therefore, to give careful consideration to all possible means of conserving this natural resource of damsites, through extension to the maximum possible of the life of our reservoirs.

How then can we take the steps to assure maximum life of our reservoirs? Many suggestions have been advanced by engineers, geologists, and conservationists. Their proposals may be generally grouped in two classes; first, proper planning, design, and operation; and second, upstream sediment-control measures.

Through proper planning and design the loss of a reservoir may be delayed. Reservoir sites should be selected at locations where, with due regard to other considerations, the rate of sediment accumulation will be at a minimum. After a site has been selected, the very least we can do is assure ourselves that sufficient space has been allowed for accumulation of sediment which will not be exceeded within the period of amortization of the project.

In many reservoirs it has been observed that finer sediments entering a reservoir will, in some cases, remain in suspension and are transported to the lower end of the reservoir, at the dam. The use of these so-called "density currents" to discharge a portion of the sediment load has appealed to many engineers. Through proper location of outlet gates and through properly planned water releases, a certain measure of the sediment load can undoubtedly be discharged. All agree, however, that this possibility offers only a partial solution. They do not agree on the amount of reduction in sediment accumulation that can be obtained.

"Stalling Off" Sedimentation

In special cases, engineers have suggested bypassing the reservoir during periods of heavy sediment flow, sluicing of deposits, or removal by other methods. Even the most optimistic agree, however, that these measures are feasible only in isolated cases where special local conditions are extremely favorable.

It can be seen, therefore, that even with the most efficient planning, design, and operation of a reservoir, the best that can be expected is to "stall off" the eventual loss of a reservoir. These measures, while highly essential, can only mitigate the evil and cannot be considered a real cure.

Engineers are conscious of the obvious fact that if sediment were controlled at its source, if it were kept in place on the land and in the stream channels, the problem of reservoir sedimentation would cease to exist. There has been almost unanimous disagreement, however, as to the effectiveness of the various methods of watershed sediment control that have been proposed.

Without attempting in any sense, to evaluate their respective merits, here is an outline of the general methods of upstream sediment control which have been proposed.

Afforestation and Forest Management—including reestablishment of forests in areas which have been cut over or burned. This also includes proper management of existing forests, including scientific timber cutting, fire control and exclusion of grazing in order to protect sprouts of new trees. It is maintained by proponents of this method that forests lower the rate of erosion, con-

serve precipitation and equalize runoff.

REGRASSING AND GRASSLAND MANAGEMENT—including revegetation of denuded areas with grasses, shrubs, vines, etc., and the maintenance of existing grassland through reseeding, fertilizing and grazing control. The purpose of maintaining grassland is to prevent sheet erosion, and the formulation and propogation of gullies.

CULTIVATION PRACTICES—including crop rotation, increasing organic matter, mulching and seasonal cover crops for the purposes of maintaining better and more continuous vegetative cover. In the same general category the practices of strip cropping, contour cultivation and terracing are intended to reduce concentration of runoff and hence soil losses.

PROTECTED CHANNELWAYS AND GULLY CONTROL—on the basis that one of the major sources of sediment is the channelways themselves, vegetative or other types of lining are intended to prevent gully formation. Where gullies have already been formed, vegetative control, diversion of runoff from gullies through terraces or water spreading devices, and the construction of check dams have been proposed as means of eliminating further gully development and the "healing" of existing gullies.

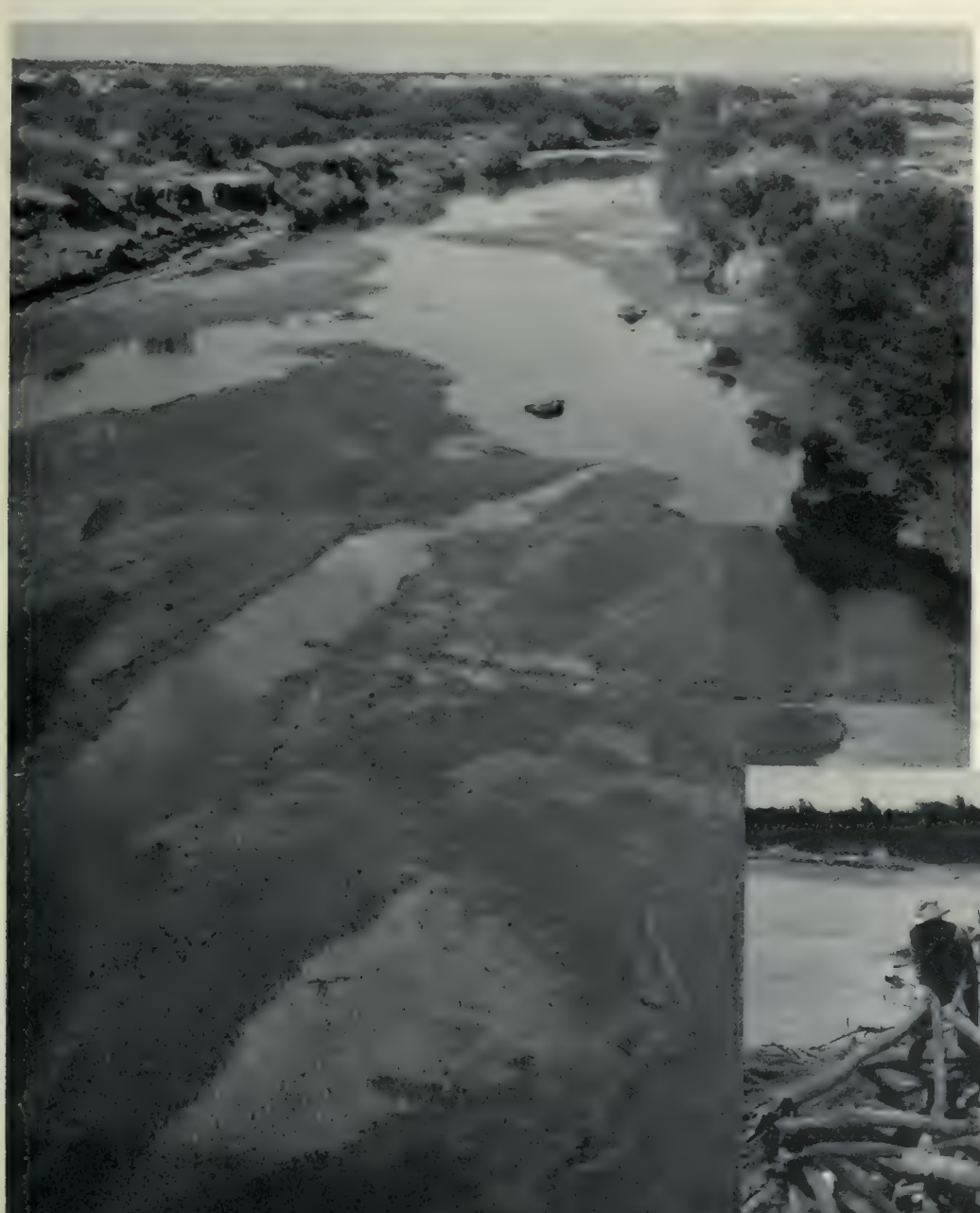
SEDIMENT DETENTION STRUCTURES—including construction of dams on tributary or main streams for the sole purpose of keeping sediment out of downstream areas. Such dams may vary from small ponds to major river structures.

WATER SPREADING—by means of various types of barriers on streams, the purposes of which are to spread the water discharging from the pool behind the barrier over a great surface. Such spreading is intended to prevent erosion by reducing concentrations of water flow, to induce revegetation of areas on which the water is spread, and, as an incidental benefit, to store sediment behind the dam.

STREAM BANK PROTECTION—to eliminate erosion of major stream banks. Two methods have been proposed. The first is to blanket the eroding area by establishment of vegetative cover, such as grass sod or a stand of willows, or by brush and wire matting. The second method is to divert the high-velocity stream flow away from the banks by jetties constructed of timber piles, trees, stones, or other material.

Other methods proposed for controlling sediment at its source include protection of flood plains by hedgerows or similar vegetation, protection of reservoir shore lines, wildlife plantings in fence rows and other wasted areas of land, and propagation of beavers for the purpose of beaver-dam construction, suggested by biologists.

The problems of reservoir sedimentation are serious and vital, and deserving of serious consideration by all associated with development and conservation of water and land resources. These problems, together with various proposed methods of control, should offer food for thought to everyone. ●



At left: Silt scars (note left bank) are prominent in this photo of the Gulf Coastal Basin, Robert Lee Project, Tex. Below: Mexican laborers installing river bank protection at Mission First Lift Pump, Valley Gravity Canal and Storage Project, Tex. Top photo by D. B. Parker, Region V. Bottom photo by Dale A. Hovey, formerly of Region V.

Multiple-Purpose Plow

by *Garford L. Wilkinson, Region V, Amarillo, Tex.*

All photos by Fred Finch, Region V

A revolutionary plow developed in the Nation's Dust Bowl a decade ago, and put to the test by producers in the Lower Rio Grande Valley in Texas may provide western irrigation farmers with the answer to their soil conservation and utilization problems.

The beneficial use of this plow to combat wind and water erosion, conserve moisture and increase production has been recognized since 1937, when drought and wind erosion combined to damage seriously 34,000,000 acres of farm land in a half dozen States. These plows have been used successfully for the last 10 years in the Great Plains States, Canada, Old Mexico, the Carolinas, and Georgia.

Widespread use of the plow in irrigated lands, however, was not initiated until 1946 when several of the largest operators in the citrus, vegetable and cotton growing areas of the Lower Rio Grande Valley made comparative tests between this "all-purpose plow" and the types of tillage machinery customarily used in the million-acre area.

The result of these tests, according to a large number of Lower Rio Grande Valley farmers, is phenomenal. For example, Jim Wade, of Edcouch, Tex., who owns and farms 2,600 acres of cotton, corn, and vegetable land, says, "this plow is the greatest plow that has ever been used in the Rio Grande Valley."

V. V. Winsett, Mission, Tex., said that the land prepared with this plow produced three-quarters of a bale per acre more of cotton than did the land prepared with the kind of machinery generally used by farmers in the region. Winsett said his test was made in the same field and that both plots received an equal amount of irrigation water.

R. H. Guinn, Edcouch, Tex., grows endive, escarole, dandelion, collards, mustard, turnips, carrots, cabbage, root parsley, and cotton. He declares that the use of this plow has cut his land preparation cost 75 percent and increased his production more than one-third per acre.

"Last year we got a fine increase in our cotton production on land prepared with this plow," Mr. Guinn said. "We grew 49 bales on 30 acres in 1947. Previously we had averaged about one-bale per acre. We also learned that less water was required on the land where we had used this new type plow."

H. G. Bannwarth, a young, good-looking farmer who lives near Mission, Tex., said he produced three-quarters of a bale of cotton per acre in 1947 on land prepared with this plow, whereas the same former lake-bed land, prepared in the usual manner, failed to return his investment in the crop.

D. J. McAlexander, farm manager for F. H. Vahlsing, Inc., Elsa, Tex., is using several of these plows on a 5,000-acre vegetable farm. "Our land preparation costs are reduced very materially by the use of this plow," said Mr. McAlexander, "and we consider it to be a valuable adjunct to our line of equipment."

Those are the statements of a few of the several hundred irrigation farmers in the Lower Rio Grande Valley who are using this plow. This is their story. The Bureau of Reclamation has undertaken no studies of the equipment or the results claimed for it. The statements by the farmers in the Lower Rio Grande Valley who are using the plow were obtained directly from them by a representative of the RECLAMATION ERA, and are being reported in the belief that the experiences of these farmers will be of interest to farmers in other irrigated sections of the West. However, no reports have been received regarding the use of the plow on irrigated lands made up of sandy soils, where deep penetration of water is a deterring rather than an advantageous factor.

THE PLOW—*R. H. Guinn, first user of the all-purpose plow in the Texas Lower Rio Grande Valley is one of its staunchest supporters because it has saved him 75 percent of land preparation costs.*

The first model of this "all-purpose plow" was fashioned in a farm blacksmith shop in the Oklahoma Panhandle during the dark days of the middle 1930's when thousands of farmers in the Great Plains area were packing up their small possessions, loading their families in dilapidated cars and fading away in the pall of smothering dust, some to become leading characters in The Grapes of Wrath.

In 1929, Bill Graham, still under 30 years of age, owned one of the prettiest farms to be found on the South Plains, near Silverton, Tex. His fields were smooth and clean. The mortgage had been reduced after each succeeding harvest. The soil, the crops and the prices for his produce foretold a life of security for the family's agricultural kingdom. Then came the crash! Wheat sold for 18 to 25 cents a bushel. It was of such small value that many Plains farmers used it for fuel. And then the rains failed!

The Great Plains area, from Canada down through the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, took on the appearance of another world—some strange planet—unbelievably barren. Former fields of waving golden grain were seared. A tour through the area was like moving up to the front line on a battlefield. Skeletons of horses and cows, broken windmills, rusted cultivators, abandoned houses and farm buildings half buried in the incessant, shifting sand, dotted the landscape.

Bill Graham remembers well that first dust storm. Men prayed for rain in those years. That Sunday afternoon, Bill Graham thought the cloud in the northern sky was a rain boiling across the horizon. He ran bareheaded from the house into the yard with arms outstretched to embrace it. A moment later, half-blinded by sand, he stumbled back into the house to help his wife dampen bed sheets, and spread them over the little baby girl to keep her from suffocating. But neither Bill Graham nor any of the thousands of Great Plains farmers could spread wet sheets over their burning fields. The land lay bare and smooth and powdered at the mercy of the winds.

For three tortuous years Bill Graham used every means available to halt erosion and stop the destruction. Nothing he did was suc-

cessful. One June day in 1937, the combine crew arrived to cut Graham's wheat. He calculated that if he helped out as a hand he might get enough for his year's work to pay for his harvesting and keep his credit at the grocery store alive. Even so, he was more fortunate than many of his neighbors.

Graham had his tractor hooked to his disk plow by the time the wheat had been harvested. "If you disk that field again, you'll ruin it," the combine man told him.

"What else can a man do?" Graham asked.

"There's a farmer up in the Oklahoma Panhandle," the combine man replied, "who has saved most of his soil and is producing fair crops right through the dust storms by using a cultivator he made himself. His name is Fred Hoeme."

Before the sun set that day, Graham was knocking on the door of Fred Hoeme in Oklahoma's "No Man's Land." But when he saw the farm implement that had been described to him by the combine man he shook his head.

"What's the matter?" Hoeme asked.

"What I need is right plowing. That doesn't look like any plow I've ever seen." Hoeme didn't argue. He took Graham out to a healthy field of wheat in which there were no signs of blowing. Across the fence on similar land lay sand dunes and barren subsoil. Hoeme then explained how he had developed the new farm tool.

THAT SAVED—***The plow is used on former waste land that has been graded and leveled, breaking up the hard plow-sole, leaving a roughed-up surface which permits maximum moisture penetration.***

During the height of the dust bowl tragedy in 1935, a highway worker had dragged a scarifier—an implement with long spikes for tearing up the surface of the roads—across Hoeme's field, digging a number of deep furrows. The next year the wheat growing where those furrows had been dug was healthy, vigorous, and over a foot higher than the wheat in the rest of the fields.

It was evident to Hoeme that the scarifier had caused the difference in the soil and the yield. He decided to build one for use on all of his farm land. He welded curved shanks three feet apart, with two-inch chisels on them, to a railroad iron. This was mounted on wheels and used to dig furrows in his wheat before the winds began to blow in the spring. He produced a fairly successful crop that first year. By planting time he rebuilt his first crude instrument into a full-scale cultivator by adding more beams and staggering the shanks so that they dug furrows 1 foot, instead of 3 feet, apart.

When Bill Graham returned to his South Plains home he took one of Fred Hoeme's new-fangled implements with him. He used it to plow deep. Graham's neighbors laughed when they saw what he was doing to his land. He didn't blame them a bit, for the fields no longer were smooth and clean, the way good farmers tilled their soil. Instead, there were little 6-inch terraces a foot apart, most of them covered with stalks, straw, grass and weeds. It was a sorry looking mess. Graham dug into the ground to see what had happened. He learned that the resilient, pumping shanks with their chisel points had penetrated the hard subsoil and opened cracks and fissures in all directions. He learned also that the powdered dirt began sifting down beneath the clods and vegetation. The wind couldn't get to it.

But Bill Graham didn't know what he had discovered until a week later when a 5-inch rain fell on the parched, hardened soil. He went into the fields to make an investigation. The water had disappeared almost as if by magic. On a smooth disked field next to his, the powdered dirt had caked and sealed over, causing heavy erosion and loss of most of the rainfall. On another field, plowed with a lister, the water had raced down the steep furrows taking part of the topsoil with it.

When it was dry enough, Graham dug holes in his fields. He found that the moisture had penetrated two to four times deeper where he had used Hoeme's implement. Later, United States Department of Agriculture employees (Soil Conservation Service) inspected the fields. Their reports showed that there was "moisture penetration to a depth of 52 inches on land which had been cultivated with the Hoeme plow."

The Soil Conservation report continued: "Moisture penetration checks were also made on adjoining land of the same slope and same type of soil at the same time and we found moisture penetration to a depth of 24 inches on land which had been cultivated with a one-way plow."

This new implement had put the moisture down deep in the subsoil to be stored and used as required by plant life.

Graham's wheat, grown on land prepared with this new type plow, produced more stalk. It sent down more feeders into the ground, and it improved in color and yield. His land required less seed than before.

This experience changed Bill Graham's life. He reasoned that if this plow would save his soil from wind and water erosion and at the same time produce larger crops, why wouldn't it help farmers throughout the world? He became a salvationist of soil. He and Fred Hoeme began making plows for other farmers in the Great Plains area. Since they made the first ones for sale, the plows have been used widely in Canada, the Great Plains States and Mexico. In North and South Carolina and in Georgia they are used for the revitalization and rebuilding of worn-out, eroded land.

Bill Graham's hopes to provide a plow for every farmer who needed one, and the idea of gearing production to an automobile-

THE PLAINS—*V. V. Winsett, Mission, Tex., farmer, is another booster for the plow. He claims greatly reduced land preparation costs and doubled cotton production.*

assembly line didn't appeal to Fred Hoeme. So in 1939 Graham bought Hoeme's patents and began manufacturing the plows in an old garage in Amarillo, Tex. There, in what has grown to be a huge factory, with a branch in Pueblo, Colo., and a business association with a steel mill, the orders for the plows pour in faster than they can be supplied.

In the years since he used the first home-made implement, Graham has added features to the plow which he had developed on his own farm and by the experiences of users all over the country. Today the plow bears but little resemblance to Hoeme's first crude device. Now it is made in widths from 8 to 34 feet, the largest model being hinged 8 feet from each end so that it will plow on three contours at the same time.

The plow is described as "revolutionary" because it goes back to the first principles in plowing—that of the aborigine with his pointed stick. The plow stirs the soil deeply but does not turn it over. Graham says this is the way God intended land to be cultivated.

Two years ago Graham produced a set of knives, a pair of them attached at an angle behind each chisel. These knives run flat just under the surface of the ground, as deep as 4 inches, and cut weeds and leave them to decay. Also they break up the continuity of the soil and thus cut off the capillary action which funnels up water to be wasted in air and lost to evaporation.

One variation added just before the war, and soon to be reintroduced as more material becomes available, is a combined plow and drill. This simply mounts drills behind each chisel or spike and you plant your grain as you plow. This, it is said, is the long-sought, single-treatment tool for grain farmers. Another variation from the regular plow is the use of strong springs on each chisel. This feature is designed for use in ground where there are large boulders. The use of the springs permits the chisels to relax when they strike an immovable object.

Lower Rio Grande Valley farmers, however, use only the regular all-purpose plows which it is claimed are built to last a lifetime, with nothing to grease or wear out.

Jim Wade, who has been an irrigation farmer in the Valley since 1917, and his two sons, J. H. and J. R. Wade, Jr., graduates of Texas A. & M., own several of these all-purpose plows, all of different sizes. They use the smaller ones on land that has been in cultivation for a number of years. The large ones are used on former waste land that is first levelled and then plowed. Large track-type tractors are required to pull the plows on land that is tight and packed as hard as concrete. However, the plow, according to Mr. Wade, never jumps out of the ground and will plow as much as 18 inches deep or as long as there is sufficient power to keep it moving.

"I've learned that by using these plows on my new and old land I can penetrate the soil to greater depths and yet leave trash and humus on top," Mr. Wade said. "It is the best and most economical plow I've ever used. It conserves moisture, the land requires less frequent irrigation, because there is less baking, and my crops produce more than I ever dreamed possible."

Lee Prater uses the all-purpose plow on his 50-acre farm at Monte Alto, Tex. "I estimate that I have cut my land preparation and cultivation cost 50 percent since I began using Mr. Graham's plow," Mr. Prater declared. "I seriously believe that Mr. Graham has done the small and big farmer of America a big favor in developing this plow."

Mr. Prater utilizes the 8-foot plow for various types of work, using a small tractor for power. "I pull my plow as deep as it will go into the ground and I use it to prepare my land for planting, to chisel my corn and cotton middles before irrigating, and to plow out my carrots. I would like for all other farmers, especially the small operators, to discover the value of this implement."

Walter Rabe and his son, Bill, farm 800 acres of irrigated land in the Valley. They have two of these new-type plows. "We have found the answers to every wish in these plows," the elder Rabe volunteered. "This includes the matter of economy, sturdiness and simple operation. They have definitely left our land in better condition than it ever was before under various methods of cultivation."

Mr. Guinn, previously mentioned, was the first irrigation farmer to use the all-purpose plow in the Lower Rio Grande Valley. He claims his one plow is doing work formerly requiring three plows. "I have made the statement repeatedly that if I could not get another Graham plow I would not take $5,000 for the one I have. This one has more than saved its cost in what I would have spent on grease alone with other types of plows," he declared.

Space does not permit more statements from the many irrigation farmers in the Valley who now use this plow, nor did time allow an interview with but more than a score of them, for each one contacted said, in effect, "let me put you up for the night so I'll have time to tell you about this plow."

Bill Graham has thousands of written testimonials from farmers in many sections of the country and reports from experiment stations which have tested the results of his plow. He appreciates the letters, but doesn't care to discuss them. At heart he remains a Texas farmer, so much so that he often keeps important business callers waiting while he chews the fat with a group of men who have had the same farming problems that he has experienced. He says that most of his improvements for the plow have been suggested by actual dirt farmers. He makes no personal attempt to sell his plows. He prefers that potential buyers talk to the men who are using them. •

Food Production Plan

(Continued from page 42)

of which would result from the normal construction program of the Bureau. However, it would be a mistake to consider this amount the total of the food contribution, or to assume that the need for such production would disappear in 1952. If it is true that Americans are consuming 25 percent more food now than before the war, and that trends from agricultural to urban pursuits are continuing, the need for greater production is apparent.

Many of the projects of the Bureau take a long time to build, even at the most accelerated rate, and many are excluded from this program because the time for construction is too short, or because nature will not fill the required reservoirs in time to be effective by 1952.

During the year 1946, all irrigated farms in the United States produced 40 million tons of crops. This figure can be doubled several times before our water supply is fully used.

It is doubtful if the dry farms will be able to maintain the bumper crop production of recent years. For several years, the great farm lands of our country have enjoyed better than normal precipitation. Any drought period in our Western States would increase the value of irrigation beyond its already important contribution to our food supply.

The type of food to be produced is very important, in an analysis of the contribution of irrigation to the world food shortage. Many of the crops cannot be produced in greater quantity economically except by irrigation, and moreover, they already occupy an important place in our needs. These foods will become increasingly critical as available supplies of grain are reduced by exports.

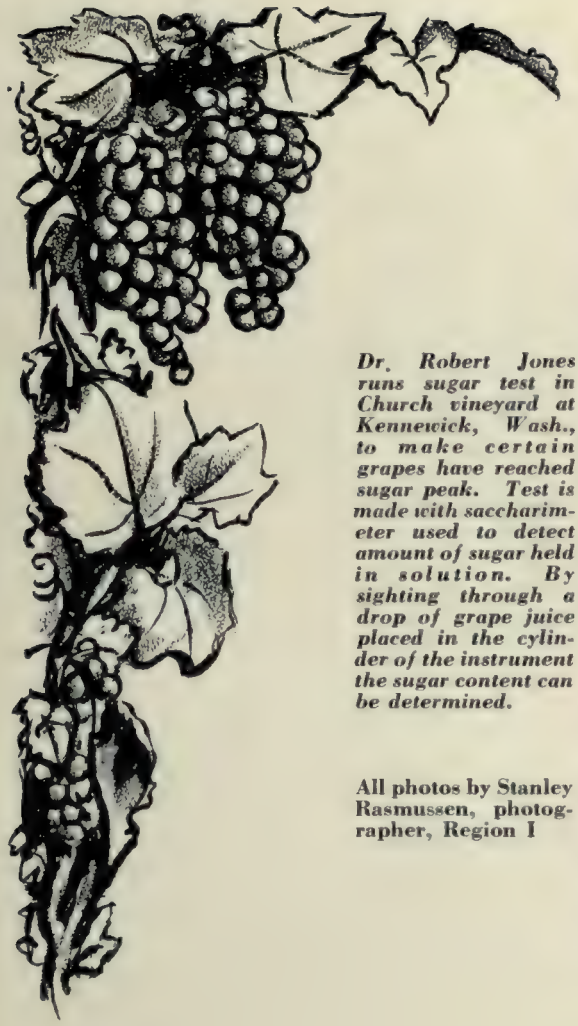
Other Benefits

It is probable that irrigation investment is one of the few ways, if not the only way, in which aid to Europe *and to ourselves* can be met without nonrecoverable grant from the Federal Government. The repayment nature of Reclamation is well known. Not so well known is the indirect manner in which the Government is repaid many times through broadening the base for taxation.

The secondary benefits of power, industrialization, and supporting communities, may far exceed direct repayments in returns through taxation.

Flood control, soil conservation, recreation, and fish and wildlife benefits are likewise important. *In short, the benefits that*

(Continued on page 60)



Dr. Robert Jones runs sugar test in Church vineyard at Kennewick, Wash., to make certain grapes have reached sugar peak. Test is made with saccharimeter used to detect amount of sugar held in solution. By sighting through a drop of grape juice placed in the cylinder of the instrument the sugar content can be determined.

All photos by Stanley Rasmussen, photographer, Region I

Grapes

Producers on the Kennewick Division of the Yakima project in the State of Washington claim their Concord grapes are sweetest

By FRANK D. MAUPIN, ***Secretary, Kennewick Project Committee, Kennewick, Wash.***

Washington State, and particularly the lower Yakima River Valley, was introduced to the Concord grape industry via the kitchen stove.

M. H. Church, a native of the Michigan grape belt, migrated to Kennewick, Wash., in 1907, when irrigation was initiated in the lower Yakima River Valley. Mr. Church brought with him a few Concord grape plants from his native State and planted them in his yard. He and Mrs. Church picked their grapes the first year and pressed them into juice in their kitchen. The little mail-order hand press they used is still in possession of the company he founded. In 1913, Mr. Church, whose business was ice and cold storage, installed a press in his ice plant and produced his first commercial grape juice.

In tribute to his farsightedness, the grape juice company retains the name of its founder, Mr. Church, who passed away 20 years ago. The company is now under the direction of F. M. Ludlow, of Kennewick, general manager; J. G. Kelly, Walla Walla, Wash., publisher, president; and Donald Sherwood, of Walla Walla, vice president.

There is a part of Washington State where Concord grapes take on a maximum amount of natural sugar, and that is around Kennewick and Pasco, where the Yakima and Snake Rivers flow into the Columbia. The altitude at Kennewick is only 365 feet above sea level, and the rainfall about 7 inches annually. The soil is reasonably light and the growing season about 2 to 3 weeks longer than other irrigated areas of the Northwest. This combination seems to account for the high sugar content and the low acidity that makes naturally sweet grape juice so palatable and desirable. The area centering at Kennewick is the only known location in the Nation where this condition exists.

Pioneering of Concords was slow, and it was not until 1937 that Mr. Church's company and others began development of this crop in earnest. That year the company

planted 500 acres of its own grapes and began contracting with private growers to do likewise. Since 1943 individual growers have planted grapes on a large scale for the reason that all processors in the area are contracting for the crops 10 years in advance, and guaranteeing a floor price of $25 per ton for the entire contract term. As a result, Concord acreage now is into the thousands of acres. In 1946 the growers were paid $80 per ton for their Concords, and even with high farm labor costs, most growers were realizing a substantial profit from their vineyards.

Yields of Concords in lower Yakima Valley is unusually high, averaging 6 tons to the acre or more. Frequently the yield is as high as 10 and 12 tons per acre. In 1945, two vineyards, one 70 acres and one 30 acres, averaged 10 tons per acre. The life of a Concord vineyard is known to be up to 60 years, and many of them 10 to 20 years old are at their peak production. Medium sandy-loam soils are among the best producers, although excellent yields are obtained in most soils from heavy to light-sandy, where good husbandry is practiced.

Over 700 growers service the Church plant at Kennewick, and probably an equivalent number for 2 other plants situated in Grandview, 40 miles to the northwest. These two plants are operated by a garden products company with headquarters in San Francisco, and a juice-producing company, subsidiary to a Chicago company, which uses juice for jams, jellies, and flavors.

The average individual planting of Concords is usually small, ranging from single-acre vineyards to 35 or 40 acres. Newer vineyards are planted in 9- or 10-foot rows spaced 8 feet in the row. This plan allows the use of ordinary farm trucks for transporting the field lugs direct to the processor with one handling. This spacing also allows for ease in cultivation, and the use of green manure for fertilization. Fertilizing programs usually include barnyard, Austrian Winter peas for green manure, and commercial 16–20.

Since the last 4 years have shown tremendous growth in Concord plantings, the county agents, State College of Washington, and the irrigation experiment station have taken an active part in the study of practical irrigation, cultivation, fertilization, and pest-control programs. Well-attended grape-grower schools are held in Kennewick, Pasco, and Grandview, where various problems are studied and discussed. Included in the agenda is field demonstrations of pruning, so important to good yields. Dr. John Snyder, of Washington State College, has conducted these schools for many years.

The Church Grape Juice Co. has recently established a research department under the leadership of Dr. R. E. Jones, plant specialist from the University of Maryland. This research work will cover all phases of grape culture, in cooperation with other agencies interested in this educational phase of grape culture.

Sugar Tells the Time

Harvest time is determined by sugar test, and when the required sugar is present the vineyards are cleaned with one picking. This usually starts about September 15 at Kennewick, and continues until October 25 in the Sunnyside area to the west.

Picking is done into 30-pound lug boxes placed in alternate rows in the vineyards. The truck drives down the clear row and the filled lug boxes are handed over the 5-foot trellis onto the flatbed truck. The truck goes direct to the processor for unloading, its weight being checked en route. The lugs are wheeled from the truck bed with standard hand trucks. The trucker then loads empty lugs and returns to the vineyards, scattering them directly ahead of the picking crew. Some pickers will pick 100 lugs a day. The 1946 wage was 14 cents per lug.

Pressing the juice is comparatively simple compared to other food processing. In the Church plant, the lugs are wheeled from the farm truck to an automatic dumper, which drops the grapes into a wash pit, and sends the empty lugs away on a conveyor. The grapes are then crushed, stemmed, and the resulting pulp pumped to the press filling stations. Here mats, or "cheeses" of pulp are made and inserted into the press, where, under 2,000- to 3,000-pound pressure, the juice is removed to the last drop. The juice is then pasteurized and placed in 5-gallon glass demijohns for storage, being rebottled later from these containers into the retail pint and quart bottles for shipment to 27 of the 48 States.

While comparatively new, the Concord grape sector of Washington farming is due for much further expansion. New York, Michigan, and Arkansas have previously supplied most markets, but all of these areas require the addition of sugar for a palatable drink. Production is declining in the Eastern grape belts, and the total for the Nation has declined from 270,700 tons in 1929 to 165,300 tons in 1946. The Washington production has shown a steady increase from 7,600 tons in 1929 to 21,700 tons in 1946, and the increase during that period has been constant.

The southern portion of the million-acre Columbia Basin project is adjacent to this area and crops similar to those produced in the Kennewick section, including Concords, will, no doubt, be grown. The initial 5,400-acre unit of this project, which is to be irrigated for the first time next spring by direct pumping from the Columbia River, will get its share of Concord plantings.

The Kennewick Division of the Yakima project, which local people are urging the Bureau of Reclamation to construct, will make an additional 16,000 acres of land available in the Yakima River area. Much of it will probably go into Concord grapes. ●

Grape mash is poured into blanket-lined tray and placed under hydraulic presses.

Closeup of six huge presses which squeeze the grape juice from the mash.

March 1948

Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management*, G. S. Ellsworth; *Chief Counsel*, Clifford E. Fix; *Chief Engineer and Director, Branch of Design and Construction*, Denver, Colo., Walker R. Young; *Acting Chief Information Officer*, Leonard W. Mosby; *Chief Personnel Officer*, Glenn D. Thompson; *Director, Programs and Finance*, Alfred R. Golze; *Director, Branch of Operation and Maintenance*, Goodrich W. Lineweaver; *Director, Branch of Power Utilization*, Harvey F. McPhail; *Director, Branch of Project Planning*, John W. Dixon; *Comptroller*, William F. Kubach; *Director of Supply*, S. W. Crosthwait.

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, H. T. Nelson; *Acting Regional Engineer (Branch of Design and Construction)*, Grant P. Gordon; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, W. H. Tuller; *Regional Power Manager (Branch of Power Utilization)*, Don S. Campbell; *Regional Planning Engineer (Branch of Project Planning)*, E. N. Torbert; *Regional Finance Officer (Finance Division)*, A. W. Empie; *Regional Information Officer (Information Division)*, H. C. Blonk; *Regional Land Officer (Land Acquisition Division)*, W. B. Wallace; *Regional Counsel (Legal Division)*, H. R Stinson; *Regional Personnel Officer (Personnel Division)*, V. L. Rushfeldt; *Regional Supply Officer (Supply Division)*, James M. McCool.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho
Anderson Ranch Dam	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Black Canyon Dam	F. E. Hulet	Power superintendent	Emmett, Idaho.
Caldwell	R. W. Adams	Engineer	Caldwell, Idaho.
Cascade	Earl Harmon	Construction engineer	Cascade, Idaho.
Notus	T. E. Nelson	Irrigation manager	Notus, Idaho.
Nyssa	J. E. Spofford	do	Nyssa, Oreg.
Vale	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes	Jacob W. Taylor	Construction engineer	Bend, Oreg.
Hungry Horse	C. H. Spencer	do	Columbia Falls, Mont.
Minidoka	S. R. Marean	Superintendent	Burley, Idaho.
Palisades	I. Donald Jerman	Project engineer	Post Office Box 1259, Idaho Falls, Idaho.
Umatilla	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.
Yakima	Olaf Lindgren	Superintendent	Federal Bldg., Yakima, Wash.
Rathdrum Prairie	Eugene Lavonture	Watermaster	Route No. 1, Post Falls, Idaho.
Project Planning Offices			
Boise (Central Snake River district)	John V. Otter	Engineer	214 Broadway, Boise, Idaho.
Kalispell	C. S. Hazen	do	Post Office Box 97, Kalispell, Mont.
Medford	F. C. Hart	do	Post Office Box 1389, Medford, Oreg.
Salem	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla	M. Boyd Austin	do	Post Office Box 718, WallaWalla, Wash.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director*, R. S. Calland; *Assistant Regional Director*, Phil Dickinson; *Assistant to the Regional Director*, U. J. Gendron; *Regional Engineer, (Branch of Design and Construction)*, A. R. McGinness; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, J. G. Lindley; *Regional Power Manager (Branch of Power Utilization)*, B. W. Creim; *Regional Planning Engineer (Branch of Project Planning)*, S. A. Kerr; *Regional Finance Officer (Finance Division)*, J. F. Kastl; *Acting Chief (Land and Right of Way Division)*, Joe H. Leech; *Regional Information Officer (Information Division)*, Max Stern; *Regional Counsel (Legal Division)*, L. O. Graham; *Regional Personnel Officer (Personnel Division)*, H. F. Osborne; *Regional Supply Officer (Supply Division)*, H. F. Halliday

	Official in charge		Address
	Name	Title	
District Offices			
Delta district	C. H. Kadle, Jr.	District manager	Post Office Box 1407, Sacramento 10, Calif.
Klamath district	Raymond R. Best	do	Post Office Box 312, Klamath Falls, Oreg.
Lower San Joaquin district	J. W. Rodner	do	Post Office Box 1270, Merced, Calif.
	O. G. Boden	Construction engineer	Antioch, Calif.
	Jeffery Nielsen	Acting field office superintendent	Post Office Box 1372, 1115 Eye St., Modesto, Calif.
	G. C. Imrie	Resident engineer	Tracy, Calif.
Sacramento Valley district	James K. Carr	District manager	Post Office Box 302, Chico, Calif.
	C. L. Hudspeth	Engineer	Post Office Box 30, 114 Second St., Colusa, Calif.
		Construction engineer	Redding, Calif.
	C. L. Brown	Acting superintendent	Post Office Box 30, Colusa, , Calif.
	R. W. Hollis	Watermaster	Orland, Calif.
Tulare Basin district	Robert B. Cozzens	District manager	406 Patterson Bldg., Fresno, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.
Project Planning Offices			
Santa Barbara	J. H. Fertig	Engineer	201 La Arcada Bldg., 1114 State St., Santa Barbara, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer (Branch of Design and Construction)*, C. A. Bissell; *Regional O & M Supervisor (Branch of Operation and Maintenance)*, A. B. West; *Regional Power Manager (Branch of Power Utilization)*, R. V. Sprague; *Regional Planning Engineer, (Branch of Project Planning)*, E. G. Nielsen; *Regional Finance Officer (Finance Division)*, M. E. Rains; *Regional Counsel (Legal Division, Los Angeles, Calif.)*, R. J. Coffey; *Acting Regional Supply Officer (Supply Division)*, O. J. Littler; *Regional Personnel Officer (Personnel Division)*, M. H. Mitchell; *Regional Progress Control Officer (Progress Control Office)*, D. A. Dedel; *Chief, Office of River Control*, C. P. Vetter.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
Gila (Construction)	Murray J. Miller	Construction engineer	Yuma, Ariz.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
All American Canal (Coachella division)	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	P. O. Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	Project engineer	Parker Dam, Calif.
San Diego	R. E. Burnett	Engineer	Escondido, Calif.
Project Planning Offices			
Escondido	R. E. Burnett	do	Post Office Box 357, 414 West 3d St., Escondido, Calif.
Overton	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix	V. E. Larson	Assistant regional planning engineer	337 West Washington, Phoenix, Ariz.
St. George	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant to Regional Director*, C. D. Woods; *Regional Engineer (Branch of Design and Construction)*, C. H. Carter; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, D. S. Stuver. *Chief, Resources and Development (Branch of Power Utilization)*, L. E. Mathews; *Regional Planning Engineer (Branch of Project Planning)*, Reid Jerman; *Regional Finance Officer (Finance Division)*, F. J. Farrell; *Regional Counsel (Legal Division)*, J. S. McMaster; *Procurement Officer (Supply Division)*, E. O. Bywater.

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area Planning Offices			
Fallon	W. H. Slattery	Engineer	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Holderman	Area engineer	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 87, Grand Junction, Colo.
Kemmerer	P. B. Delong	Engineer	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	Area engineer	46 East Center, Post Office 294, Logan, Utah.
Spanish Fork	P. R. Neeley	do	Post Office Box 71, City Hall, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Texas

Acting Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Special Assistant to the Regional Director*, E. T. Giles; *Regional Engineer (Branch of Design and Construction)*, O. I. Craft; *Regional O & M. Supervisor (Branch of Operation and Maintenance)*, R. S. Bristol; *Regional Power Manager (Branch of Power Utilization)*, A. H. Sullivan; *Regional Planning Engineer (Branch of Project Planning)*, Rex R. Reed, *Assistant Regional Finance Officer (Finance Division)*, C. L. Harris; *Regional Counsel (Legal Division)*, S. L. Baird, *Regional Personnel Officer (Personnel Division)*, H. F. Kirby; *Regional Progress Control Officer (Progress Control Office)*, D. R. Burnett; *Regional Supply Officer (Supply Division)*, I. G. Campbell.

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	J. A. Callan	Acting construction engineer	Altus, Okla.
Balmorhea	J. A. Maverty	Engineer in charge	Balmorhea, Tex.
Carlsbad	H. H. Kidder	Project superintendent	Carlsbad, N. Mex.
Rio Grande	L. R. Flock	do	U. S. Courthouse, El Paso, Tex.
Elephant Butte Power & Storage	Leben Becker	Acting division superintendent	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta	F. D. Postle	do	Ysleta, Tex.
San Luis Valley	W. H. Sweet	Acting project engineer	117 Jefferson St., Monte Vista, Colo.
Tucumcari	R. J. Lyman	Project superintendent	Tucumcari, N. Mex.
Valley Gravity	John C. Thompson	Acting project engineer	McAllen, Tex.
Project Planning Offices			
Albuquerque	J. L. Muts	Area planning engineer	Post Office Box 98, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	H. P. Burleigh	do	Littlefield Bldg., Austin, Tex.
Oklahoma City	M. G. Barclay	do	Post Office Box 498, 816 Oklahoma Natural Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Yale Building, Post Office Box 2130, Billings, Montana

Regional Director, Kenneth F. Vernon; *Assistant Regional Director*, W. E. Rawlings; *Assistant to the Regional Director*, George O. Pratt; *Regional Engineer (Branch of Design and Construction)*, C. G. Anderson; *Acting Regional Supervisor (Branch of Operation and Maintenance)*, E. F. Landerholm, *Regional Power Manager (Branch of Power Utilization)*, J. R. Walker; *Acting Regional Planning Engineer (Branch of Project Planning)*, C. T. Judah; *Regional Finance Officer (Finance Division)*, Duncan Mills; *Regional Land Officer (Land Acquisition Division)*, W. N. McCormick; *Regional Counsel (Legal Division)*, W. J. Burke; *Temporary Chairman, Interior Missouri Basin Field Committee*, W. G. Sloan; *Chief, Reports Staff, Missouri Basin reports*, Mills E. Bunger; *Regional Personnel Officer (Personnel Division)*, A. W. Gaede; *Acting Progress Control Officer (Progress Control Division)*, W. E. Weedman; *Regional Supply Officer (Supply Division)*, Fred W. Gilbert.

	Official in charge		Address
	Name	Title	
District and project offices			
Yellowstone district	Donald C. Ketchum	Acting district manager	Box 1264, Billings, Mont.
Fort Peck	Allen Mattison	Resident engineer	Box 1245, Fort Peck, Mont.
Yellowstone pumping unit	R. B. Kuebler	Engineer	Box 720, Miles City, Mont.
Hardin unit	F. R. Dickey	do	Box 516, Hardin, Mont.
Buffalo Rapids	A. H. Whitmore	Acting construction engineer	Terry, Mont.
Moorhead Dam	E. J. Wick	do	Gillette, Wyo.
Upper Missouri District	William P. Price, Jr.	Acting district manager	Box 1720, Great Falls, Mont.
Milk River	H. W. Genger	Superintendent	Malta, Mont.
Canyon Ferry	William P. Price, Jr.	Construction engineer	Box 517, Helena, Mont.
Sun River	C. L. Bailey	Superintendent	Fairfield, Mont.
Big Horn district	R. H. Workinger	Acting district manager	Box 839, Cody, Wyo.
Shoshone-Heart Mountain	W. F. Kemp	Acting project engineer	Box 900, Cody, Wyo.
Boysen and Owl Creek	R. S. Lieurance	Project engineer	Box 1111, Thermopolis, Wyo.
Riverton	T. A. Clark	Acting project engineer	Riverton, Wyo.
Missouri Souris district	Bruce Johnson	Acting district manager	Box 328, Bismarck, N. Dak.
Missouri Souris, N. Dak	G. J. Cheney	Engineer	Box 1869, Minot, N. Dak.
Missouri Souris, Mont	H. W. Mutch	do	Box 986, Wolf Point, Mont.
Cannonball Dam	Floyd Jensen	Construction engineer	Elgin, N. Dak.
Dickinson Dam	Bruce Johnson	Acting district manager	Box 328, Bismarck, N. Dak.
Heart Butte Dam	Bruce Johnson	do	Box 328, Bismarck, N. Dak.
Missouri Oahe District	Joseph W. Grimes	do	Box 825, Huron, S. Dak.
Angostura and Rapid Valley	H. V. Hubbell	Project engineer	Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Newell, S. Dak.
Bixby Dam	H. M. Crowell	Construction engineer	Faith, S. Dak.
Keyhole Dam	F. W. Goehring	do	Moorcroft, Wyo.
Shadehill Dam	D. M. Forester	do	Lemmon, S. Dak.

REGION VII: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director*, W. E. Blomgren; *Acting Regional Engineer (Branch of Design and Construction)*, Herbert E. Prater; *O. & M. Supervisor (Branch of Operation and Maintenance)*, John N. Spencer; *Power Manager (Branch of Power Utilization)*, Harold R. Lee; *Planning Engineer (Branch of Project Planning)*, John A. Keimig; *Regional Finance Officer (Programs and Finance Division)*, Kenneth L. Smith; *Land Officer (Land Acquisition Division)*, Mark W. Radcliffe; *Regional Counsel (Legal Division)*, Clarence Eynon; *Personnel Officer (Personnel Division)*, Albert R. Novak; *Supply Officer (Supply Division)*, William F. Sha; *Administrative Officer, (Administrative Division)*, H. S. Varner, Jr.

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Casper (North Platte Basin)	I. J. Matthews	do	Do.
Guernsey (power)	John T. Hicks	Engineer	Guernsey, Wyo.
Guernsey (irrigation)	Nels P. Nelson	District irrigation superintendent	Do.
Kortes	C. S. Rippon	Construction engineer	Casper, Wyo.
Seminoe Dam	E. T. Walters	General foreman	Seminoe Dam, Wyo.
South Platte River district	E. S. Huntington	Acting district manager	Building 11, Denver Federal Center.
Colorado-Big Thompson	Vacancy	do	Estes Park, Colo.
Fort Morgan	G. W. Hall	Foreman	Fort Morgan, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Green Mountain Dam	W. E. Bumpas	Power manager	Green Mountain Dam, Colo.
Horsetooth Reservoir	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	Matt C. Bowman	do	Loveland, Colo.
Blue-South Platte project	J. H. Knights	Area engineer	Building 11, Denver Federal Center.
Narrows Dam	Charles Seger	Construction engineer	Fort Morgan, Colo.
Kansas River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Enders Dam	U. V. Engstrom	Construction engineer	Imperial, Nebr.
Medicine Creek	Clifford L. Mutch	do	McCook, Nebr.
Cambridge Diversion Dam and Cambridge Canal.	C. M. Jackson	do	McCook, Nebr.
Cedar Bluff	R. J. Walters	do	Ellis, Kans.
Culbertson Dam	Vacancy	do	Trenton, Nebr.
Bonny Dam	Wayne S. Byrne	do	St. Francis, Kans.
Ainsworth (Niobrara Basin)	C. E. Burdick	Area engineer	Ainsworth, Nebr.
Grand Island (Platte River investigations)	P. L. Harley	do	Grand Island, Nebr.
Pueblo (Gunnison-Arkansas and Upper Arkansas River Basin).	B. F. Powell	do	Box 515, Pueblo, Colo.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	W. J. Farrell	Boise, Idaho.
Boise (Payette division, Notus unit)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	R. B. Gregory	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo	Carl Hicks	do	C. J. McCormick	Grand Junction, Colo.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo	J. J. Flanagan	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	Clifton, Colo	W. A. Long	do	Elmer Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont.	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	J. D. Large	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	[illegible]	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	Superintendent.	Louie Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hilbel	do	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	S. F. Griffin	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	William T. Davis	Brigham City, Utah
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	O. L. Norman	Manager	J. F. Griswold	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Rudolph Hope	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Al Hiat	Superintendent.	Mabel M. Richards	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	David C. Brooks	do	Pauline Osterhout	Sunnyside, Wash
Yakima (Tieton division)	Yakima Tieton irrigation district	Yakima, Wash	Guy Finley	Manager	Guy Finley	Yakima, Wash.

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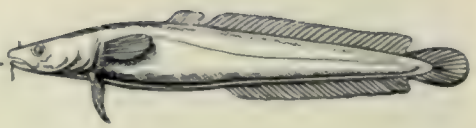
Irrigation supply for Kennewick grape area is provided by Bureau of Reclamation.

These eleven grape juice pasteurizers are in constant around-the-clock service during harvest season at the Church Grape Juice Co., Kennewick, Wash.

Just a small portion of the finished product derived from the Church Co.'s output which averages a million gallons monthly during the season.

Ling Fishing



by H. P. Vogt

Safety Inspector, Riverton Project, Wyo., Region VI

Ocean Lake, commonly called the Ocean, that 6,300-acre natural basin filled with a year-round supply of drain water from the irrigation system, lies within the heart of the Riverton, Wyo., project. It offers fishing opportunities the year round—perch, crappies, blue-gills and bass—but during the winter season, when the ice really forms, it becomes the mecca of the ling fisherman.

The ling is a member of the codfish family and the only American member of that family inhabitating fresh water. It is thought to be a native of the Wind River headwaters and peculiar to this area. To the uniformed, he appeared as a hybrid—a hyphenated version of a fish, with an eel body and a catfish mouth.

The mottled, olive-colored skin is best removed with a pair of pliers, revealing a chicken-white meat firmly adhering to the well defined backbone. The general appearance is no tribute to the edibility of this lazy, slow moving, carnivore.

He seems to prefer feeding on animals found near aquatic growth, as experienced fishermen claim that the best place to set the lines is just above a moss-covered area. The ling will not rise to a lure, a fly, or a fast moving bait; but place a live minnow on a weighted set-line near Mr. Ling's habitat, and the results are generally quite satisfactory. He does not hit the bait in the manner of other game fish; he mouths it, and then the swallowing process starts. Devotees of this sport often have the experience of losing a ling the moment his large mouth leaves the water. As soon as he breathes the fresh air, the fish opens his mouth and falls back immediately, indicating that it was merely holding the bait.

These conditions and characteristics make fishing through the ice the great sport that it is at Ocean Lake, just 15 miles west of Riverton on the road to Yellowstone Park. It lures people from all parts of the country.

The ice hole digger at work.

Although the ling is caught during the day, the confirmed fisherman claims he feeds better at night. Local authorities contend that clear, cold nights are preferred; the ice should be at least 10 inches thick, with very little snow covering; the less wind the better, and with a rising barometer you have perfect ling-fishing conditions.

Upon arriving at Ocean Lake, the members of the fishing party will hurriedly set up camp unless they are cummuting back and forth between a nearby camp, ranch, or town. Then comes the labor of cutting the holes for the set lines. No party will be satisfied with less than 20 lines. The chalk lines are then baited with live minnows (preferred length, about 6 inches), weighed, and tied to a stick which rests across the holes. (Incidentally, it is illegal to use carp minnows in Wyoming.) Then at about 3-hour intervals, the lines are "run," the fish are taken off, and the hooks are rebaited. Rebaiting is not always necessary if the ling hasn't swallowed the minnow.

It is no uncommon sight to see several cars traveling slowly on the ice, while the headlights are used to "run" the lines. This is by no means a mild experience. Leaving camp is no feat, but after traveling on the ice for the better part of an hour with other cars in the distance, the landmarks become indistinct. After returning to camp, sometimes only by the guidance of other more orientated fishermen, the party will spend its time consuming gallons of hot coffee and probably using a deck of cards to determine the dishwasher for the following day. After about 3 hours, the lines are run again. Should it be an exceptionally cold night, a roaring sagebrush fire is extremely appropriate. The next morning the lines are run for the day and preparations made for the next night's luck, probably by cutting more holes in a different area.

The 20-mile shore line of Ocean Lake offers ample opportunity for free fishing. If the adjacent land is privately owned, all that is necessary is for the fisherman to get permission to cross. Some areas are still public domain and "no trespassing" signs are not the general rule.

The Wyoming State Game and Fish Department has acquired a tract joining Ocean Lake which is to be developed into a State park. This is in accordance with the trend to keep this area free of private and Federal isolation. The Missouri River Basin staff of the United States Fish and Wildlife Service has made preliminary studies, evaluating the wild-life resources, in keeping with such programs wherever water impounding is planned.

However, some commercialization has invaded even this area. About 10 years ago one of the project farmers whose land was partly inundated by the then rising waters of Ocean Lake, recognized its commercial possibilities. He put up a few cabins and offered meal service, but his greatest drawing card was the fact that he had minnows for sale. He recently sold his place, which was not valued for its farming potentialities, for a considerable sum. Another camp nearby is going into the business of catering to the ling fishermen in a big way. A satisfactory restaurant, a dozen cabins, and above all, a mechanical ice hole digger, are featured attractions. Week-end reservations must be made in advance. This digger, with a hole drilling attachment, is available for fishermen at a dime a hole. This is probably the only one of its kind in use, as the auger had to be specially fitted with saw teeth.

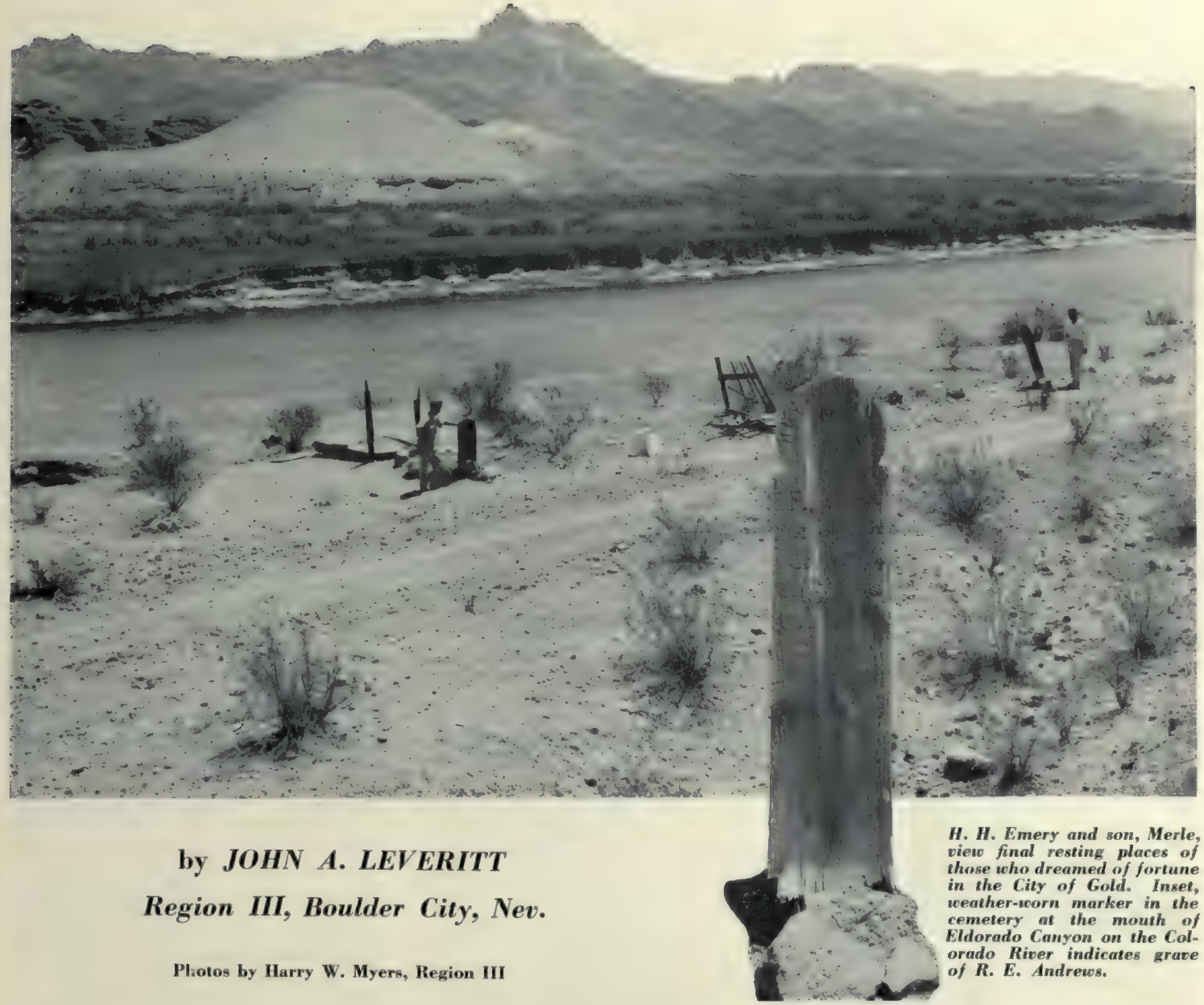
The matter of supplying minnows has become more than a passing problem. They can be purchased at the fishing camps for $0.75 a dozen. One of the owners of the camps one season employed two men full-time to spend their time keeping his tanks stocked with minnows. These two camps will use, during a poor season, several thousand dozen minnows for their customers. Several people have made the sale of minnows their principal winter income in Riverton. One of these stated that he could sell up to 10,000 dozen if he were equipped to handle them properly. These minnows are caught in the streams of Freemont County and then hauled to the ocean. Some authorities feel that an opportunity for minnow farms exists here.

It is estimated that 10,000 ling are taken each season, which is principally between December and February as the ling spawn in early March. They generally vary from 1 to 14 pounds, the average being about 4 pounds. Some fishermen contend that the ling are fewer and smaller than they were a few years ago. This may be a matter of conjecture, but the State Game Department points out that the failure to "run" the lines causes the greatest waste of fish. The Department estimates that a thousand ling die each season simply because they are left on the lines—a serious potential menace according to these authorities.

They point out that this may cause a condition experienced in another State. Dead fish were washed up by the waves and piled 3 and 4 feet on the shores. Neighboring farmers were forced to vacate. Game officials wearing masks cleaned the area at an enormous expense. This is the reason Ocean Lake fishing is encouraged the year-round under proper procedure. It is estimated that only a tenth of the crappie, for

(Continued on inside back cover)

Thirteen Graves in Eldorado



H. H. Emery and son, Merle, view final resting places of those who dreamed of fortune in the City of Gold. Inset, weather-worn marker in the cemetery at the mouth of Eldorado Canyon on the Colorado River indicates grave of R. E. Andrews.

by *JOHN A. LEVERITT*

Region III, Boulder City, Nev.

Photos by Harry W. Myers, Region III

Romantic tales of an almost forgotten mining camp on the Colorado River 30 miles below Hoover Dam are being brought to light by the construction of Davis Dam by the Bureau of Reclamation.

This rambunctious camp, located at the mouth of Eldorado Canyon and known as Eldorado, thrived for about 50 years and then withered. It was established by some of the lusty pioneers who roamed the West during the mid 1800's in a mad search for precious gold and silver deposits.

During an investigation of the area which will be inundated when Davis Dam is completed, Bureau engineers looked over the few remaining vestiges of the once riotous community and discovered that the camp's cemetery would be near the reservoir line—in danger of being washed away.

Since the cemetery, which lies on a gravel bluff overlooking a fishing dock now known as Emery's Landing, would have to be moved, attempts have been made to identify the occupants of the thirteen remaining graves. This has been difficult, as only three of the graves are marked and existing records of the camp are scanty, but the search has uncovered some interesting legends.

It is not known definitely when Eldorado was established, but gold was probably first found in the canyon in 1857 when the Honest Miner mine was discovered. Claims were made between 1857 and 1859 for some of the other better mines in the canyon such as the Techatticup, Wall Street, Quaker City, and Mockingbird.

The mines were up the canyon from the river, but the main camp was established on the river bank since water was necessary for the mill and bringing supplies in by river boat from Yuma. There is a highly improbable estimate that by 1863 there were as many as 1,500 people in the area. No one can prove it, however.

Those who first laid out the camp underestimated the strength of the Colorado. Most of the camp was built right on the river and the site is now the bed of the stream—the river changed its course during one of the high floods. Merle Emery, who runs the fishing dock at Eldorado, says that wagon wheels, mill equipment and other property from Eldorado may still be found on the river banks downstream.

About all that remains of Eldorado are two of the mill buildings which were on higher ground, an antiquated steam tractor

which was designed to pull the ore wagons from the mines to the mill, and the cemetery. A large stack of broken whisky bottles adjacent to the cemetery seems to prove a saloon was once nearby.

For more than a half century the 13 remaining graves have baked in the desert sun and weathered the rare but torrential downpours. It is said that two-thirds of the cemetery was washed away when the river was on one of its rampages before Hoover Dam was constructed in 1931–36.

Some of the mounds have been so weather-beaten that they are hardly discernible. Two of the markers are of wood and the epitaphs are barely legible. Apparently the names and other information were painted on and now, although the paint has faded, the printing stands out in faint relief against the weather-worn wood.

The other marker is a neat, white marble headpiece incongruously standing in this drab, cheerless spot. The stone marks the last resting place of Cornelius Conover who died May 26, 1888, at the age of 56. Despite the influence Conover must have once had to rate such a comparatively elaborate marker, nothing has yet been learned about him.

The other two marked graves are those of R. E. Andrews, who died August 25, 1881, and Lars Frandsen, who died May 12, 1897. Frandsen is the only one of the three who died in such a fashion that his demise is remembered in legend.

The handful of oldtimers who live in the area still recount the yarn occasionally as they loaf away an evening at the Twin Gables general store at Nelson, Nev., the town which replaced Eldorado as headquarters for the area about the turn of the century.

On May 12, 1897, Frandsen and another teamster were driving two of the huge ore wagons down the canyon from one of the mines to the mill at Eldorado. The teamsters stopped at Huess Spring, 1 mile below Nelson, to rest and water their horses. On a bluff overlooking the spring hid Avote, a surly Paiute Indian who had worked around the area for some time and was well known for his jealousy concerning his good-looking squaw. The story goes that he had been heard muttering threats regarding his suspicions of Frandsen and the other teamster. As the men mounted their wagons to leave, Avote blazed away and shot them both.

When the wagons were overdue for several hours, a man was sent to investigate and found one man mortally wounded and the other dead. After this shooting, Avote apparently decided to wipe out all the white men in the canyon and give it back to the Indians. He ran amuck. His next victim was Charlie Nelson, for whom the town of Nelson was named.

Later he sneaked up to the cabin of Charlie Monohan, a partner in the mining firm of Monohan and Murphy, and killed him. The next morning Judge Morton was preparing breakfast in his cabin. He had not heard of the killings. From his doorway he saw Avote coming over the hill and put on some extra beans and coffee for the Indian. Avote accepted the hospitality and then, quite inhospitably, shot the judge.

By this time the whole canyon was up in arms and after Avote. A posse of white men was formed, but was unable to locate the wily Paiute. It took an Indian to track an Indian, and so the posse—as was often done in those days—resorted to that stratagem. A party of Indians, threatened with dire consequences if they did not capture Avote dead or alive, found him on Cottonwood Island, several miles downstream, and brought his head back in a burlap bag to save their own skins.

This story, one of many of murder and mayhem in the canyon, is told by Yeoman Briggs, a former accountant from the East who has several claims in the area and has worked them himself since 1931. Briggs, a gregarious chap, has collected a great deal of the lore of the canyon, but he admits that much of the information and many of the stories probably are not too accurate. He presumes that the other teamster (name unknown) was also buried at Eldorado, but has no way of proving whether the others Avote shot might be among those who were buried in the unmarked graves of Eldorado.

Briggs has a chronological history of the camp gained from mining company records, the few published works mentioning the canyon which he has been able to find, and from talking with the older residents. During the Civil War and only a few years after gold was discovered, the camp probably was about as large as it ever became.

A few years after the war, the Barker brothers of Philadelphia purchased the Techatticup mine and formed the South West Mining Co. In a short time the company controlled all of the proven mines in the canyon. Until 1900 this company dominated the life of the whole community.

The Barkers were absentee owners and so the managers of the company were the bigwigs of Eldorado during this period. Perhaps the most famous of these managers was Charlie Gracey who first worked as a blacksmith in the camp. Gracey was a religious man and deplored the morals of the rip-roaring mining camp. There is a story that Gracey insisted upon two cemeteries, one for Christians with a chance for Heaven, and the other for the renegades. Only two gained admission to the Christian cemetery. Briggs says there is no factual basis for this story, that it was originated to illustrate Gracey's piety and the general cussedness of the rest of the camp.

The era of the South West Mining Co. ended in 1900. The next generation of Barkers became involved in a mining deal in South America and mortgaged the property to finance it. They lost out and the property was sold to Joseph Wharton of the Wharton Steel & Iron Co.—a dominant figure in the nickel-mining business. A Philadelphia Quaker, Wharton was one of the richest men in the country and his three visits to his property in Nevada were big events.

(Continued on inside back cover)

MUTE EVIDENCE *of the fact that there was once a large gold mining settlement at the mouth of Eldorado Canyon is this old steam tractor. It was used to move ore to the mill, located near the river because of the availability of water.*

AFGHANISTAN'S Reclamation Program

Afghanistan, in mid-Asia half a world away, has much in common with the United States when it comes to Reclamation.

In a recent visit with Commissioner Michael W. Straus, in Washington, D. C., His Excellency, Mohammad Kabir Ludin, Minister of Public Works, who, only a decade ago, was a State Department trainee placed with the Bureau of Reclamation, discussed such mutual problems as repayment policies, acreage limitation, and river-basin developments.

Mr. Ludin is proud of being a "graduate" of the Bureau of Reclamation. Ten years ago when he was completing his Master of Civil Engineering degree at Cornell University and contemplating work towards a doctorate, one of his professors advised him that 1 year with the Bureau of Reclamation would be worth two Ph.D.'s in engineering.

After a year in Reclamation's Denver, Colo., office, where he studied all fields of operation under such able teachers as former Chief Designing Engineer Jack Savage and Mr. Ivan Houk, Mr. Ludin returned to his own country. There, carrying with him memories of what Bureau engineers had accomplished in the West, he had visions of entering public service and doing the same to benefit his countrymen. Mr. Ludin was named Chief of the Bureau of Reclamation of Afghanistan and rapidly rose from this position to the one he now holds as Minister of Public Works. In this latter capacity he has laid out a modern and efficient irrigation development.

Mr. Ludin told Commissioner Straus that Afghanistan has started on a $17,000,000 program for irrigating the Helmund and Kabul River Valleys. Power is to be a byproduct of reclamation and its sale will help pay construction costs for the development. The repayment period for farmers to pay construction costs will be 35 to 40 years. The charge will be interest free. Settlers will be limited to an acreage of some 20 to 30 acres. Thus, it can be seen that in many ways Mr. Ludin is putting into effect practices similar to those of our western States.

When it comes to river-basin developments, Mr. Ludin expressed great interest in the Bureau of Reclamation's world-famous plans, such as the Columbia and the Missouri River Basins.

This is another way in which this Middle Eastern country and the United States are similar in their river-basin developments.

Photo by Glenn Peart, Dept. of Interior photographer

U. S. Commissioner of Reclamation Michael W. Straus talks over future irrigation developments with His Excellency Mohammad Kabir Ludin of Afghanistan.

Irrigation is nothing new among the Afghans. Mr. Ludin spoke with pride of a 1,000-year-old dam that was in good working order till about 70 years ago. Most amazing of all, when engineers started to construct a new dam downstream from the ancient 100-foot-high masonry structure, the original wooden outlets of the first were found to be still in good condition. This dam was built on a tributary of the Helmund River in the time of Sultan Mahmood of Ghazni. The foundation of the structure, Mr. Ludin said, followed the zigzag course of the natural contour of a rock outcrop, making it an early model of a keyed-in gravity dam.

New irrigation works in the Helmund and other valleys will be coordinated with present systems. The first jobs will be built near centers of population. Mr. Ludin explained that Afghanistan has massive mountains which make road building difficult. There are no railroads in this far corner of the globe. All transportation is motor borne.

As Minister of Public Works, Mr. Ludin is also head of road building in his country and is embarked on a vigorous, well-rounded program of economic development. He looks forward to the time when great highways will make it possible to increase Afghanistan's exports, primarily to India and the United States. He says they now do a very good business with America in the sale of caracul furs and chemical herbs, such as asafetida.

This little country, the size of Texas, exports some 2,600,000 caracul skins a year to America. The skins range in price from $10 to $15. According to Washington, D. C., furriers, it takes about 30 to 40 of these skins from newborn lambs to make a full-length Afghan lamb coat which retails here in the $600-to-$800 bracket plus the 20 percent Federal tax on furs.

Afghan cattle raisers, just like our western stockmen, depend on irrigated pastures and alfalfa crops to feed their stock. Other crops grown in fertile, artificially watered, valleys of Afghanistan are apricots, figs, peaches, plums, grapes, and pomegranates. The yield from these is comparable to that of crops grown on Reclamation's Yakima project in the State of Washington, where agricultural values average $800 to $1,000 an acre.

Mr. Ludin says that the fertility of Afghanistan lands has not decreased with the centuries of constant irrigation. He attributes this to the use of fertilizer and the fact that farming is done in small family-size units with very few large land holdings.

Although irrigation farming comprises 40 to 50 percent of agricultural enterprise in Afghanistan, in good years wheat is a

profitable dry-farming crop. Rainfall in Afghanistan's irrigated areas averages 4 to 12 inches a year with 15 to 20 inches in the hilly sections.

Afghan farmers who depend on muscular energy for much of their power look forward to the day when electrical energy from the rivers will help do their work for them. Mr. Ludin says his country now has 12,000 kilowatts of hydroelectric power and expects to increase this 20 times over within the next 12 years. In addition to domestic and industrial needs, he explained an important use of hydropower will be in the electrolysis of minerals.

The Helmund River plan, now under construction, is the first great project in Afghanistan's $17,000,000 irrigation, hydroelectric power and road-building program. This calls for the development of 20,000 kilowatts of electricity and 200,000 acres to be brought under ditch. In the next 10 years, Afghanistan plans to spend $100,000,000 on irrigation and hydroelectric power development. This is the forerunner of a long-range development program, plans for which have not yet been completed.

Reclamation in the United States has contributed richly to forwarding the development of Afghanistan's river resources. Through his training in the Denver office, and contacts made in this country, Mr. Ludin has been able to draw upon American engineers and contractors for assistance in carrying out a sound Reclamation program in his own country.

He believes that his country has benefited many times over from his "postgraduate course" with the Bureau of Reclamation. He spoke with pleasure of the recent visits to Afghanistan of two American engineering consultants, Mr. Jack Savage and Mr. S. O. Harper. The former once was Chief Design Engineer and the latter was former Chief Engineer of Reclamation.

When he posed with Commissioner Straus before a map of Coulee Dam, Mr. Ludin became interested in pointing out the designs that he, personally, had helped to work out when he was studying in Denver.

The Minister of Public Works in Afghanistan says he keeps up on current Reclamation developments by reading the RECLAMATION ERA. His visit to this country has a twofold mission: To discuss contracts with American firms who are building irrigation and power works in Afghanistan and to arrange for other young Afghans to have the same opportunity that he did to study with the Bureau of Reclamation and learn new techniques in river taming. ●

Bamian Valley, Afghanistan.

Top left: Depth readings are indicated in fathometer, operated by Richard Redmond. Top right: Aboard the sounding vessel, Lawrence Miller, left, and Harley Nygren, right, sight shore markers through sextants as Dave Whipp, rear, plots boat's position, and Wallace Short, seated, records angles and readings. Lower left: Fathogram of bay floor. Lower right: Mechanical "fish."

All photos by H. W. Fuller, Region I

The Depths of Lake Roosevelt

by Wafford Conrad, formerly employed at Coulee Dam, Wash., Region I

Lake Franklin D. Roosevelt, one of the longest man-made waterways in the world, is being sounded and charted by the Coast and Geodetic Survey, the Federal agency charged with preparing nautical charts for navigable waters controlled by the United States.

The Bureau of Reclamation reservoir stretches 151 miles from Coulee Dam, Wash., to the Canadian border. Large boats can navigate the lake its entire length, and small boats can continue on up the Columbia River from the lake to Revelstoke, British Columbia, nearly 200 miles farther north.

Lake Roosevelt was formed in 1942 by Columbia River water backed up behind Grand Coulee Dam. Three years later the United States Coast Guard installed directional lights along the waterway to mark the main channel for skippers of the runabouts, sailboats, hydroplanes, excursion boats, logging tugs, and other craft on the lake.

The war's end created a need for detailed surveys of the reservoir and its approximately 600 miles of shoreline. The Bureau of Reclamation, which built the dam and purchased a narrow strip of land all around the reservoir, wished to know the extent of shore erosion and the location of possible new slide areas. The National Park Service needed additional data to carry out its plans for developing the recreational resources of Lake Roosevelt. Both agencies realized that eventual drawdown of the reservoir by Columbia Basin project power developments would make navigation hazardous unless a nautical chart were available.

The Coast and Geodetic Survey is making both topographic and hydrographic surveys to obtain data for a nautical chart showing water depths, menaces to navigation, shore features, and artificial aids to navigation.

To the landlubber, the taking of echo soundings is the most interesting phase of the work. By bombarding the floor of the lake with sound waves and measuring the time required for their echoes to reach the surface, a nearly continuous profile of the lake bottom is obtained.

Millions of soundings will be required to map the lake floor, but that's not as big a job as it sounds because the electrical device used makes 12 soundings a second.

The device, known as an 808 Fathometer, produces the sound waves, receives and amplifies their echoes, measures the time interval, and converts this interval automatically into units of depth measurement, such as feet, fathoms, or meters.

The 808 Fathometer is a semiportable instrument for hydrographic surveying from small vessels. It consists of three separate units: The power-producing batteries, a recorder cabinet, and a streamlined submersible housing called the "fish." The "fish," which sends out the sound waves and catches their echoes, is suspended from the side of the boat and resembles a baby torpedo as it bores through the water just under the surface.

Key gadgets in the recorder cabinet are a motor generator which converts direct current from the batteries into high voltage current, a condenser, a vacuum-tube amplifier, a timing mechanism, a rotating stylus arm, and a Fathogram.

The acoustic transmitting and receiving units are inside the hollow wooden "fish." Each consists of a bundle of laminated nickel plates wound with rubber-covered wire and resembling a transformer core. They are immersed in water which enters the "fish" through holes in two thin metal plates on its underside.

Electrical impulses cause the laminated plates in the "fish" to vibrate and emit sound waves. Their echoes, reflected from the lake floor, are picked up by the receiving unit in the "fish," converted back into electrical impulses, amplified in the recorder cabinet, and recorded on the Fathogram.

The Fathogram is a revolving roll of calibrated paper, coated on its underside with aluminum or copper. The electrical impulses travel down the stylus needle to the paper and burn a jagged carbon path in making electric contact with the metalized underside. The carbon trail is a graphic record of the profile of the lake bottom over which the sounding vessel has traveled.

In evaluating the Fathogram record, allowances must be made for the temperature of the water because the Fathometer is calibrated at 4,640 feet per second—the speed of sound in fresh water at approximately zero Centigrade. Lake Roosevelt water varies from about 14° to 15° C. (57.2° to 59° F.), and at these temperatures the sound waves travel approximately 4,775 feet per second. Water temperature is tested at intervals by lowering a combination thermometer and water sampling cup into the lake from the sounding boat. The water samples are tested for salinity, which also influences the speed of sound in water. The salinity factor is negligible in Lake Roosevelt.

Deepest sounding made so far is 65 fathoms, or 390 feet.

Soundings are taken from a converted Navy landing craft. Crew members live on a Bureau of Reclamation dormitory barge which was used in reservoir clearing operations during the building of Grand Coulee Dam.

The course of the sounding vessel up and down the lake is determined by sighting through sextants at markers which have been placed about every 400 yards along the shores. Whitewashed rocks, metal drums painted white, varied-colored flags, and cheesecloth-covered wooden pyramids serve as markers.

A topographic survey crew establishes the markers. This crew is divided into three parties. One, working from a 36-foot Bureau of Reclamation launch, erects the hydrographic signals and compares the shoreline with aerial photographs made from a Coast Guard plane in 1946. A shore party locates triangulation stations established by the Bureau before the reservoir was created to determine what land areas would be inundated. These old stations are then located on the aerial photos. Another shore party contacts residents of the reservoir area to check the accuracy of local names given adjacent canyons, flats, and other natural features, makes recommendations for naming unnamed geographic features, and classifies area roads as to type for mapping purposes.

Both the hydrographic and topographic surveys are directed by Lt. Commdr. J. T. Jarman of Meridian, Miss., who joined the Coast and Geodetic Survey in 1927 upon obtaining his degree in civil engineering from the University of Mississippi. Commander Jarman knows the value of nautical charts. During World War II he spent more than 3 years on a Navy survey ship mapping the uncharted battle areas of the South Pacific.

When the Coast and Geodetic Survey completes its work in the fall of the year, the data will be used by the National Park Service in compiling a master map of the reservoir area for purposes of long-range planning and administration. Besides indicating underwater and shoreline contours, the map will show towns, highways, and railroads in the reservoir area, boundaries of Bureau of Reclamation, Indian Service, and Forest Service lands, navigational lights, safe harbors in event of storms, suitable landing places and picnic spots, fueling facilities, and lake resorts.

Claude E. Greider, director of the Park Service's Coulee Dam office, says a special map then will be made up to provide complete information for tourists, fishermen, picnickers, and others wishing to take advantage of Lake Roosevelt's oustanding recreational opportunities. ●

ECHOES ***from Grand Coulee Dam to Canada recorded at Franklin D. Roosevelt Lake, Wash., aboard this Coast Guard cutter.***

First Missouri Basin Municipal Water Contract Approved

The form of the first contract for municipal water service under the Missouri Basin plan has been approved by Assistant Secretary of the Interior William E. Warne and forwarded to the city of Dickinson, N. Dak., for execution. The form of the contract was informally approved by city officials before it was submitted to the Department of the Interior for final approval as to form.

The contract is written under authority of section 9 (c) (2) of the Reclamation Project Act of 1939, and under its terms the city of Dickinson will receive a city-unit water supply at the outlet works of Dickinson Dam.

Farm Land Values Reach Peak

According to the United States Department of Agriculture, the period 1942–47 brought a greater percentage increase in farm real estate values for the United States as a whole than any 5-year period in the last 36 years. There are no data for earlier periods. Between March 1942 and March 1947 values of farm real estate rose 75 percent compared with 65 percent from 1915 to 1920, the 5 consecutive years with the greatest value increase during the World War I period.

Riverton and Shoshone Heart Mountain Drawings Held

Governor Lester C. Hunt of Wyoming was the principal speaker at the public drawing held on December 4, 1947, in Riverton, Wyo., which established selection preference for 55 public land farms in the Riverton project.

This is the first postwar public land opening on this project. More than 2,700 inquiries were received after July 10, 1947, when the opening was originally announced, and almost 500 persons from 27 States and the District of Columbia filed applications for the Government farms.

Governor Hunt in his message to the group at Riverton stressed the vast changes in the West brought about by Reclamation. He said "reclamation is a vital element in increasing production, and must go forward vigorously. No other agency has accomplished such positive results, added so much wealth, or carried on its operations in such a democratic way as the Bureau of Reclamation."

Governor Hunt drew the first name (Yeats W. Causey of Hemingford, Nebr.). Mayor William B. Glass of Riverton; Preston Brooks; Dr. J. A. Vincent of Riverton, commander of the Power River Post, Veterans of Foreign Wars, and Ralph H. Workinger, acting district manager of the Big Horn district, each drew a name from the bowl and Miss Joye Stagner, rodeo queen of Fremont County, selected the remainder of the names of those found eligible for participation in the drawing.

Shoshone-Heart Mountain

On January 6 of this year, Governor Hunt again presided over a similar drawing on the Shoshone-Heart Mountain project held at Cody, Wyo.

Widespread interest was also shown in this public land opening with a total of more than 6,000 inquiries being received and 632 applications for 31 farms actually filed by closing time.

Regional Director Kenneth F. Vernon of the Bureau of Reclamation was on hand for the drawing along with Paul Purvis, commander of the Cody Post of the Veterans of Foreign Wars, and Jack Stahn, representative of the Powell Post of the American Legion. Vernon emphasized the value of the vast acreages in the West as one of the Nation's greatest assets to produce the foods so badly needed to "feed a hungry world."

He then reviewed briefly the Bureau's activities in the Missouri Basin and emphasized the benefits that would accrue to this great midland empire through the full conservation, control, and utilization of the Basin's water resources.

A Way With Waterweeds

Details of a chemical formulation for controlling waterweeds in irrigation channels will be included in the revised publication of the Bureau of Reclamation, "Control of Weeds on Irrigation Systems." (See p. 39 FEBRUARY RECLAMATION ERA.)

This is an example of recent finding from research work conducted in the Bureau's chemical laboratory in Denver. If the chemical proves to be as effective in general as initial tests indicate, it will reduce considerably the cost of controlling these pests.

Also much more has been learned about the comparatively new weed control chemical 2, 4–D through the research program and tests conducted by the Bureau's Regional weed specialists. The revised edition will contain a broader discussion of this chemical which has been found to be of particular value in reducing the costs of willow control on ditchbanks.

Shasta Power Returns $3,000,000 Plus

The sale of power generated at Shasta Dam, a key feature of the Central Valley project in California, plus rent from the Orville transmission line brought a revenue of $3,530,896.87 for fiscal year 1947. Most of the revenue will go toward repaying the construction cost of the project.

For comparative purposes the cost of operating the Shasta power plant and appurtenant structures during the 1947 fiscal year (June 1946 to July 1947) was $471,073.40. This amounts to approximately one-seventh of the revenue received from these works during the calendar year of 1947.

Hathaway Succeeds Straus As Head of Large Dams Committee

Gail Hathaway, special representative to the Chief of Engineers, Department of the Army, and vice president, Zone II, American Society of Civil Engineers, was elected chairman of the American National Committee of the International Commission on Large Dams at the organization's meeting in Washington, D. C., January 16. Mr. Hathaway, who succeeds Commissioner of the Bureau of Reclamation Michael W. Straus, will take office July 1.

Election of Mr. Hathaway to the committe's chairmanship climaxed a program devoted largely to completing plans for participation by the United States at the Third International Dam Congress next June in Stockholm, Sweden. At least 35 American engineers plan to meet with other delegates from 25 foreign countries.

Nineteen papers were selected by the National Committee for presentation at the World Power Conference. Subjects of the papers include cement for large dams, dams on frozen foundations and reactive aggregates.

The Stockholm conference will be the first since the end of World War II. The American National Committee had been reactivated last year under the direction of Commissioner of Reclamation Straus.

Plans for the Stockholm conference include a study tour to several Swedish dams and hydroelectric plants.

Food Production Plan

(Continued from page 48)

accrue from the normal reclamation program will be speeded by an accelerated program.

Additional Expense Involved

The principal factor increasing costs would be the resorting to "speed up" methods of contracting, such as cost-plus-a-fixed-fee, which might be necessary in some cases, and to the use of employees inexperienced in Reclamation construction, assuming that material prices and wages do not materially increase. Otherwise, in high-speed construction such as building a 4-year project in 2 years, there are many savings, principally in overhead and investment charges, that tend to offset increases.

Taking all of these factors into consideration, it appears to be a reasonable assumption that increased costs would probably not exceed 25 percent of the normal expected cost of the project.

Use of Critical Materials

Reclamation projects are ordinarily classed as "heavy" construction. That is, work involving massive masonry, earth moving operations, and the like, as opposed to the "light" construction of buildings, homes, industrial plants, etc., that require relatively large amounts of processed material in this construction. In dam construction, earth and rock-fill types predominate.

Concrete dams use locally processed cement, which is not believed to be of significant export importance, and the aggregates are usually found at or near, the site. Structures such as canals consist almost entirely of excavation.

A study made in the spring of 1946, in cooperation with the Civilian Production Administration, disclosed that the Bureau did not use significant amounts of building materials in relation to total national production. Items such as brick, wall board, structural tile, clay and cast iron pipe, gypsum board, etc., are incidental.

Lumber is used to a greater extent for concrete forms and for temporary buildings but is not now considered critical in the western areas.

A study of our requirements in connection with "National Resources and Foreign Aid" by Secretary of the Interior J. A. Krug, report dated October 9, 1947, indicates that some trouble might be expected in the following items:

(*a*) Reinforcing steel:
(*b*) Electrical materials;
(*c*) Construction equipment, especially automotive cars, trucks, tractors;
(*d*) Gates, valves, and other heavy machinery and control devices.

The extent to which our needs for the above items would conflict with other essential uses can only be estimated in their relation to the total production of such items. If it can be safely assumed that uses more essential than food will not absorb the entire production, then no serious problem would be presented.

Reclamation by Drainage

Any estimates of additional land that could be placed into production by the Bureau of Reclamation within the next few years would not be complete without reference to the desirability of reclaiming land by drainage.

In many areas of the country, particularly in the South Central and Southeastern States, where rainfall is ample, there are many thousands of acres of fertile land that can be placed into production in a short time by drainage projects. This land is now waterlogged and unproductive.

The work required in reclaiming lands by drainage is very similar to that of reclamation through irrigation.

Information is not available on which estimates of costs could be prepared at this time, but plans for increased food production both in the present crisis and in later years should not overlook this tremendously fertile field of operations. In addition to repayment, all of the other benefits of reclamation by irrigation, such as increased taxation, decentralization, settlement opportunities for veterans, and others, would undoubtedly accrue were such drainage projects to be undertaken.

The basis for the achievement of the accelerated reclamation program to the extent shown depends upon the following factors:

- that the necessary funds will be made available within the next few months;
- that existing restrictions on personnel, methods of contracting, force-account work, Denver office design work, and similar items will be lifted; and
- that an administrative organization will be permitted that can carry out such a program in an efficient and expeditious manner. * * *

DENVER SCIENTISTS AWARDED PRIZE

Last January, one of the highest engineering awards in the country was given to R. F. Blanks, Division Chief, and H. S. Meissner, Head, Basic Concrete Research, Office of the Chief Engineer, Denver, Colo., for their paper entitled "Deterioration of Concrete Dams Due to Alkali-aggregate Reaction," which was published in Volume III of "Transactions," and at the presentation was termed the outstanding paper on construction.

The highly competitive award was the Thomas Fitch Rowland prize, the third oldest established by the American Society of Civil Engineers, having been instituted by the Society in 1882. The award this year was the sixty-second by the society. The prize consists of $60 in cash (to be divided between the authors), with engraved certificates signed by the president and executive secretary. In awarding the prize, preference is given to papers describing in detail accomplished works of consruction, their cost, and errors in design and execution.

The president of the ASCE, Edgar M. Hastings, presented the award to Mr. Meissner, who received the certificates and the prize in behalf of himself and Mr. Blanks at the January 21 morning session of the annual meeting of the American Society of Civil Engineers held in New York City.

Among the distinguished guests was His Excellency Mohammad Kabir Ludin (see story on p. 45 of this issue) who was asked to speak, and gave a brief résumé of the schooling he had received in this country, followed by his training in the Bureau.

R. F. Blanks and H. S. Meissner.

NOTES FOR CONTRACTORS

Contracts Awarded During January 1948

Specification No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1950	Columbia Basin, Wash.	Jan. 6	Radial gates and hoists	Northwest Marine Iron Works, Portland, Oreg.	$22,713
1950	do	do	Radial-gate hoists	Western Gear Works, Seattle, Wash.	13,642
1960	Davis Dam, Ariz.-Nev.	Jan. 15	Circuit breakers and disconnecting switches for Mesa switching station.	Westinghouse Electric Corp., Denver, Colo.	30,097
1990	do	Jan. 23	Air compressors, aftercoolers, and air receivers for Davis power plant.	Worthington Pump & Machinery Corp., Denver, Colo.	17,937
2011	Columbia Basin, Wash.	Jan. 21	Hydraulic turbines for Grand Coulee power plant, schedule 1.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	2,503,920
2011	do	do	Governors for Grand Coulee power plant, schedule 2.	Woodward Governor Co., Rockford, Ill.	122,875
2023	Missouri Basin-Frenchman-Cambridge unit, Nebraska.	Jan. 15	Construction of Medicine Creek Dam and access road.	C. F. Lytle & Amis Construction Co., Sioux City, Iowa.	4,270,006
2027	Colorado-Big Thompson, Colorado.	Jan. 9	Steel structures for switchyard at Estes power plant.	Bethlehem Steel Co., Bethlehem, Pa.	42,300
2034	Central Valley, Calif.	Jan. 28	Structural steel for 230-kilovolt switchyard at Keswick power plant.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	36,829
2050	Columbia Basin, Wash.	Jan. 21	Structural steel for emergency bulkhead for drydock, Grand Coulee Dam.	Gunderson Bros. Engineering Corp., Portland, Oreg.	41,401

Construction and Supplies for Which Bids Will Be Requested During March and April 1948

Project	Description of work or material
Boise, Idaho	Electric heaters and miscellaneous equipment for Anderson Ranch power plant.
Boise-Payette, Idaho	Earthwork and structures for Sand Hollow and Willow Creek wasteways.
Central Valley, Calif.	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado	Construction of about 50 miles of 69-kilovolt wood-pole transmission line from Brush to Yuma, Colo.
Do	Construction of about 16 miles of 69-kilovolt wood-pole transmission line from Loveland to Longmont, Colo.
Columbia Basin, Wash.	Completion of Grand Coulee pumping plant, warehouse B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of feeder canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, and water storage reservoir for mason addition streets, sidewalks, and curbs; assembly of caisson seat form and face caisson; and rock excavation for feeder canal between headworks and station 35+25.
Do	Deicing motor generator set for Grand Coulee left switchyard.
Do	2,000-kilovolt ampere transformer for Grand Coulee switchyard.
Do	Metal canopy for right control bay, Grand Coulee power plant.
Do	Steel doors for right control bay, Grand Coulee power plant.
Davis Dam, Ariz.-Nev.	Construction of 14 miles of 34.5-kilovolt wood-pole transmission lines near Yuma, Ariz.
Do	Construction of 30 miles of 115-kilovolt wood-pole transmission lines, with overhead ground wire, from Coolidge dam to substation ED5.
Do	22- by 19-foot radial gates (high head) for Davis Dam.
Deschutes, Oreg.	Completion of construction of Wickiup dam and relocation of forest service road near Lapine, Oreg.
Do	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base.
Gila-Wellton-Mohawk, Ariz.	Construction of check and turnout on Gila Gravity Main Canal.
Hungry Horse, Mont.	Air compressors for Hungry Horse power plant.
Klamath-Tule Lake, Oreg-Calif.	Construction of earthwork and structures for Coppeck Bay Area.
Klamath, Oreg-Calif.	Improvements of about 7 miles of Lost River Channel through Poe Valley.
Lewiston Orchards, Idaho	Equipment for water treatment plant.
Mirage Flats, Nebr.	Erection of office building, three prefabricated residences, warehouse, utility buildings, well pump-house and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin-Angostura, S. Dak.	50 by 30-foot radial gates for Angostura Dam.
Missouri Basin, Colo.	Erection of 16 prefabricated residences at Narrows Dam Government camp.
Missouri Basin, Nebr.	Construction of approximately 2,500 feet of 63-inch monolithic or 60-inch precast concrete siphon for Cambridge Canal.
Do	Construction of Meeker diversion dam, a temporary pile and timber structure, and canal excavation.
Missouri Basin, Nebr.-Wyo.	Construction of approximately 38 miles of 115-kilovolt wood-pole transmission line from Cheyenne to Pine Bluffs, Wyo.; construction of approximately 45 miles of 115-kilovolt transmission line from Gering to Alliance Nebr.
Missouri Basin, Kans.	Erection of 25 prefabricated residences, office building, warehouse, laboratory and utility buildings; furnishing and installing utilities for Cedar Bluff government camp.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Provo River, Utah	Construction of steel pipe line and structures for Big Cottonwood section.
Provo River-Aqueduct, Utah	72-inch diameter Big Cottonwood siphon, Salt Lake aqueduct.
Riverton, Wyo.	Construction of 12 apartments at Riverton, Wyo.

LING Fishing

(*Continued from page 52*)

example, are taken that should be caught to keep an optimum fish population.

But this ocean is still the winter fishermen's paradise. It is a matter of record that an addict set his line with a 5-inch minnow. A 14-inch large-mouthed black bass got hooked. An 8-pound ling couldn't resist this tempting meal, and the result was two big fish, all in the matter of 4 hours. To the unitiated, this may sound profane, but local addicts are not scoffers of such tales, as they all know these things are apt to happen when fishing for ling on Ocean Lake. ●

Eldorado (*Continued from page 54*)

Records of the Post Office Department, in the National Archives in Washington, show that a post office was established in Eldorado on January 23, 1879, and the last postmaster was Charles Gracey when it was discontinued August 31, 1907, 2 years after the big flood of 1905. Thereafter the mail was sent to Nelson.

The moving of the post office to Nelson probably marks the end of Eldorado as a settlement of any consequence in the area. There are no indications that the camp was flooded while it was still occupied by very many of the miners. Probably it had already lost its significance and was practically a ghost town when the 1905 flood struck. It might be said that the Colorado River created the settlement and then wiped it out. The history of the river is full of such incidents which occurred until the Bureau of Reclamation brought the unruly stream under control by the construction of Hoover Dam. ●

Our Back Cover

MOUNT SHASTA as seen from the desert side in Siskiyou County, Central Valley Project, California. This photo was taken by J. E. Fluharty of Region II.

Mt. Shasta

v. 34, no. 4

APRIL
1948

Featuring:

The Life of Hoover Dam

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Flame Throwers *versus* WEEDS

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Reclamation in Switzerland

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THE Reclamation ERA

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REGION V: H. E. Robbins, Acting Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.
REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Letters to the Editor

BOX 100, JEROME STAGE,
PRESCOTT, ARIZONA,
FEBRUARY 7, 1948.

DEAR EDITOR:

Enclosed is a check for $3 for which please extend my subscription to the RECLAMATION ERA.

I inspected your Gila project a short while ago. Those fellows are doing a wonderful job there. On January 23, I saw a crew of men getting ready to line a ditch with concrete just south of the railroad tracks at Avalon. Altho there must have been 30 or 40 men working there, and various types of equipment were being used, not one fellow was idle for a minute, no one was waiting for someone else, to begin his part of a job. There was team work with efficiency seldom seen

(*Continued on Page 78*)

OUR FRONT COVER

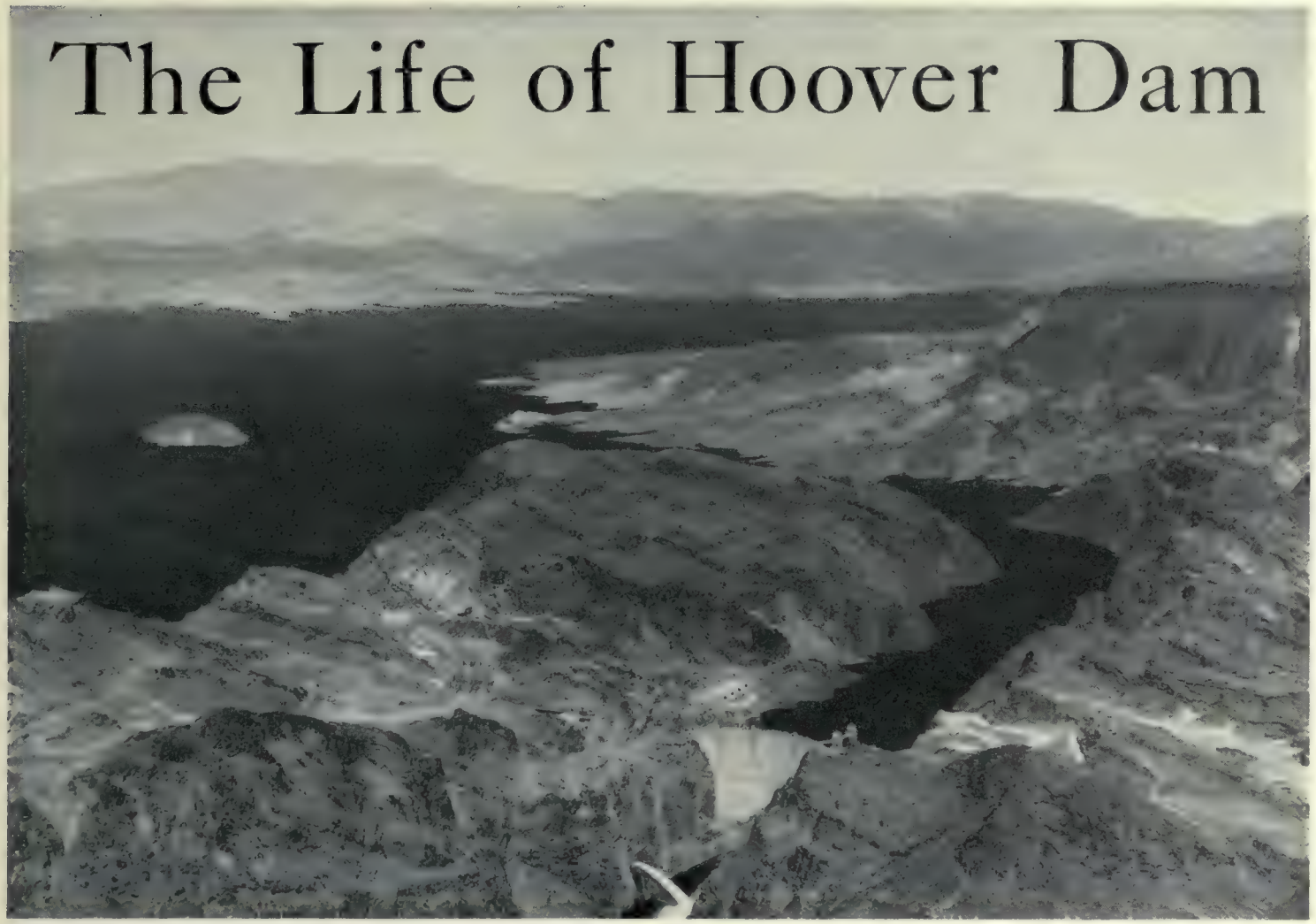
Succulent Sorghum

Proving the photogenic qualities of sorghum, this unusual close-up reveals nearly matured Bonita Grain grown on the W. C. Austin demonstration farm. The photograph was taken by Ray M. Reynolds, former Region V photographer, and for more information about sorghums, turn to page 67.

Credits

The interesting drawings which appeared in the March 1948 issue on pages 45, 49, 51, 52 and 56 were the work of Shirley Briggs of the Drafting and Graphics Section in Washington, D. C., who also prepares the map showing reclamation place names for this and forthcoming issues. Shirley Briggs' line drawings appear on pages 64, 67, 71, and 74 of this issue.

The Life of Hoover Dam



by **E. W. LANE,**
Consulting Hydraulic Engineer, Office of the Chief Engineer,
and
J. R. RITER,
Chief, Hydrology Division, Branch of Project Planning, Denver, Colo.

How long will it be before Lake Mead fills with silt?

How long will the Hoover Dam power plant continue to generate hydroelectric power?

Many people, knowing that some reservoirs have rapidly filled with sediment and become worthless, have been uselessly worrying about the life expectancy of Lake Mead and Hoover Dam power plant on the lower Colorado River. An examination of the facts, however, amply demonstrates that these fears are not justified, and that this reservoir can be counted on to be highly beneficial to the Southwest for centuries to come.

The rate at which the reservoir will fill with silt depends upon the weight of sediment carried into it each year, and how much reservoir space a ton of sediment will take up, on an average. It also depends upon how much sediment will be carried out of the reservoir along with the water.

All of the sediment coming into a reservoir does not flow smoothly down and level itself off like water. Much of it accumulates in a delta-like formation at the upper end of the reservoir, and builds itself up above the reservoir level. Because of this sloping deposit, it takes more sediment than water (by volume) to fill a reservoir, and anyone who estimates the filling time of a reservoir, on the basis of its water storage capacity, is estimating much too low.

A number of different people have studied the rate at which Lake Mead will be filled with sediment. They are unanimous on the point that it will have a long, long life. However, there is considerable disagreement on how long a life this will be, based on uncertainty about how much value should be assigned to each of these four factors:

- the average annual weight of sediment inflow,
- the average weight of sediment per unit volume,
- the average annual outflow of sediment and
- the sediment storage above the spillway level.

The different viewpoints on these individual factors cause the wide variation in estimates.

In planning Hoover Dam, the Bureau of Reclamation made an extremely conservative estimate to the effect that if no

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sediment flowed out of the reservoir, if none was deposited above the spillway level, and no reservoirs were created upstream, it would take more than two hundred years to fill the reservoir, at a rate of filling of about 137,000 acre-feet per year. Even this estimate is known to be too low, although it has remained the official prognostication, pending the availability of additional, up-to-date, specific data.

This estimate, however, must be taken with a grain of silt, when you consider the density currents—currents of heavy muddy water which tend to flow as a stream along the bottom of the reservoir under the clear lake water above. As soon as the reservoir fills to the lowest gate in the outlet towers, these density currents, laden with sediment, reach the dam, then the lower gates of the outlet towers and then begin to flow out through the power plant. The amount will increase as the reservoir fills, eventually becoming a very large factor in self-silt removal. Also, the level of the sediment surface at the head of the reservoir when it is completely filled will certainly be higher than the spillway level, perhaps as much as a hundred feet or more. Both of these actions will add considerably to the life of the reservoir.

A detailed survey of the volume of sediment deposits in Lake Mead has recently been started. When this is completed, it will be possible to make a more accurate estimate of the future filling rate than is possible at present.

Another factor which may lengthen the initial estimate is the sediment erosion control measures to be taken in the Colorado River watershed. This will considerably reduce the sediment load. The Department of the Interior and other Federal agencies are actively interested in measures to reduce the erosion of the soil in this watershed, not only for the reduction of the sedimentation of Lake Mead and other projects, but also because of numerous other resulting benefits. Although at present no one knows exactly how much soil erosion control will be carried out, any such measures would help prolong the life of this reservoir.

However, to a considerable extent, estimates made at the present time on the life of the project have little importance. It is safe to say that long before the silt deposits of Lake Mead cause any worry as to its reservoir capacity, the regime of the river will be completely altered.

There is very little doubt that it will be necessary to construct additional dams upstream to provide the storage necessary for flood control, water supply, irrigation and power, long before the time silt accumulates to a point where it is detrimental to the functioning of Lake Mead and the Hoover Dam and power plant.

If the necessary storage for water supply and flood control is provided at sites upstream from Hoover Dam, the electric power which could be generated at the dam, in the extremely remote event that the reservoir becomes completely filled with sediment, will be as great as if the reservoir were not sediment filled. In fact, an even greater amount of power would be generated with a filled reservoir, since the total fall available at the dam could be used continually, while now it is used only for the very small part of the time when the reservoir is full.

When the original studies for the Boulder Canyon project were made, it was expected that the development of the resources of the lower Colorado River would proceed steadily through the succeeding years, and it was estimated that dams would be built upstream which would so reduce the sediment inflow that only about 10 percent of the reservoir capacity would be filled in 50 years.

The demand for power in the Southwest is growing rapidly and the need for additional power sources is already being acutely felt. Studies are now being actively carried on to investigate the desirability of constructing dams on the main river above Lake Mead, at the Bridge Canyon and Glen Canyon sites. At this latter site a storage capacity of more than twice that in Lake Mead will be possible if the rock is found to be strong enough to support so high a dam.

In any case, a very large reservoir here is possible, which would keep most of the sediment out of Lake Mead for a century or more. Reservoirs above Lake Mead for the specific purpose of storing sediment are under consideration on the San Juan and Little Colorado in connection with the construction of the Bridge Canyon Dam and the development of additional irrigation in the Colorado River watershed. It therefore appears likely that additional storage structures will soon be constructed above Lake Mead and that the estimate of 10 percent of the reservoir capacity filled in 50 years made by the original planners of the project will not be far from the actual result.

It is evident, therefore, that the life of the Boulder Canyon project is assured for centuries to come and that the benefits of this great project of Southwest will be felt without diminution for as long as, in this day of rapidly advancing science, it is worthwhile to try to look ahead. •

_____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

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Flame Throwers *versus* WEEDS

by **STANLEY E. JONES**

and **L. B. SHINN**

Tulare Basin District, Calif., Region II

No "blowblack" with flame thrower gun. ***Ben Glaha Photo.***

Peacetime prospects in store for many of the lethal weapons of World War II appear mighty slim. Doomed to a future of inactivity under a cover of cosmoline and rust inhibitors, many a weapon that helped the war is now lying idle for want of a peacetime use.

Take the Army flame thrower for instance. Its deadly prowess in the recent Pacific campaign will be vouched for by any Marine or doughboy who personally had to rout out a stubborn enemy from pillbox or cave. Its influence over enemy resistance is unquestioned. Adaptation to some worthwhile peacetime use is another thing entirely. Sure—some funster was seen using one during the record New York City snowstorm last Christmas week, but it is extremely doubtful that the United States Army Flame Thrower M2–2 will replace the United States civilian snow shovel.

When the Bureau of Reclamation asked the United States Army Chemical Warfare Division for the loan of two flame throwers, the idea was not snow, but weed, eradication. The spectacular flame thrower had been a challenge to weed control men since it was first issued by the Army, so when the opportunity came to borrow the equipment, ex-Marine and Army personnel in the Bureau staff at Bakersfield, Calif., lost no time in getting experiments under way to test the adaptability of the flame thrower in killing weeds on ditchbanks and around works inaccessible to conventional weed burning equipment.

The Buena Vista Water Storage District of Kern County at the southern end of California's great Central Valley afforded a good place to test the flame thrower along its 205 miles of ditches. While not a recipient of Bureau of Reclamation water, the Buena Vista water storage district has always been cooperative and eager to aid the Bureau in testing any promising device or material that would also aid them in their fight against weeds. Weed problems of the area are as severe as that of any district in the West. Canals and ditches are choked with tules, pond weeds, and other water weeds; their banks are lined with smartweed, willow, quack grass and Johnson grass.

Although many methods of weed control are now used, and the discovery of more and more efficient chemicals has increased the popularity of chemical weed control, burning weeds on ditchbanks still has its place under some conditions. Sportsmen and wildlife conservationists may rest assured that particular care is taken to prevent injury to wildlife during the burning process. The Bureau of Reclamation realizes that tall weeds and shrubs furnish protection and cover to wildlife, but in view of the narrowness of the ditchbank area, and the necessity to remove weeds from drain and canal banks in order to operate and maintain the irrigation system efficiently, it is believed that those who understand both the menace of weeds and the urgent need for free-flowing irrigation water will agree that weed-burning along ditchbanks is justifiable.

Weed burning trials with the flame thrower on the district's canals were made with the following purposes in mind:

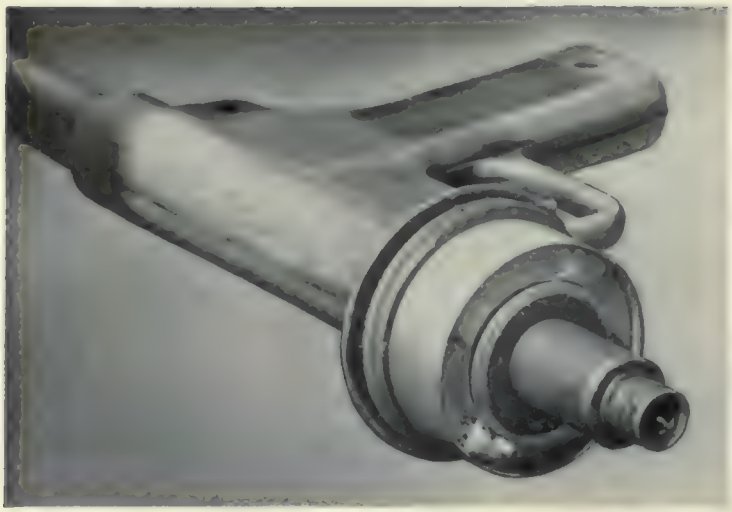
1. To determine its feasibility as an eradicator of weeds common to ditch banks around irrigation structures in areas which ordinarily cannot be reached by conventional weed-burners and heavy equipment.

2. To test the effectiveness of various fuel mixtures in killing and retarding weed growth.

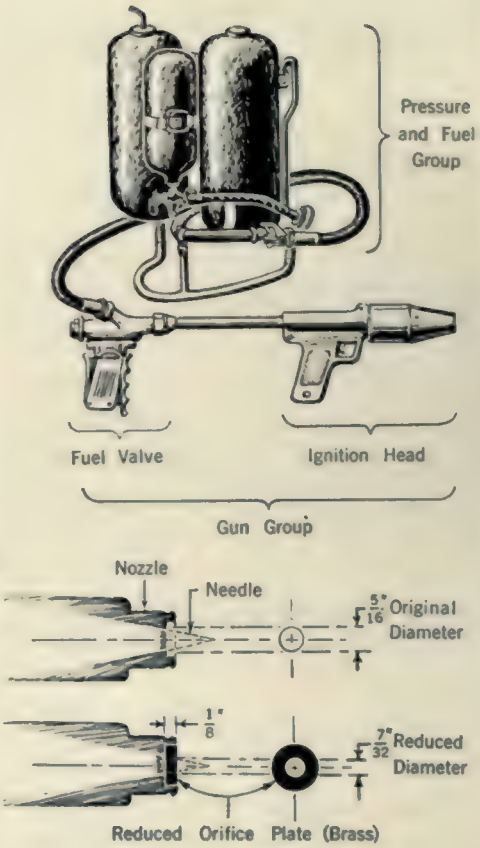
3. To determine costs of operation, considering the degree of burn, the area covered, and the relative costs of fuel mixtures.

4. To determine modifications and improvements that would enhance its practicability as a weed eradicator to be used by the Bureau along the 156 miles of the Friant-Kern Canal.

The burning trials were performed under variable conditions using several different fuel mixtures. First used was



At left, the flame thrower gun with shield off, showing the modification made in the orifice, consisting of a ring fitted inside the center "point" of the gun. At top right, the original United States Army flame thrower M2–2, and below, diagrams showing how the orifice plate was reduced in order to assure a constant pressure of 250 pounds per square inch. (*Original sketches submitted by Region II, finished art work by Shirley Briggs.*)



the Chemical Warfare Service's formula for wartime purposes—a fuel consisting of a mix of 3 gallons of 100 octane gasoline, 1 gallon of diesel oil, and 1 pound of napalm thickener (a glycerine-like substance of high cohesive quality) with the pressure tank charged with 1,200 pounds of nitrogen per square inch. The burn, using this fuel, though spectacular and intense in initial appearance, was far from complete, merely charring most of the vegetation. Close examination of willows, for example, showed little more than searing of the outside layers of the stems with no permanent damage to growth.

The most satisfactory results were obtained in another test when equal parts of 100 octane gasoline (2½ gallons) were used with one pound of napalm and 1,300 to 1,700 pounds pressure of nitrogen per square inch. The mixture provided a prolonged burn of 3 to 5 minutes which resulted in partial to complete charring of the more resistant woody vegetation.

In an attempt to determine the value of cheaper fuels, diesel oil alone and a mix of diesel and crankcase drainings were used. In both cases the initial burn appeared intense and enduring. However, an examination of the smoke-scarred woody tissues after the trials indicated only partial destruction with no complete killing effect.

More modification—flame thrower gun mounted on "spray rig" burner. *Photo by Ben Glaha, Chief Photographer, Region II.*

A trial using 2 gallons of 72 octane gasoline, 2 gallons of diesel oil and 1 pound of napalm at 1,300 to 1,700 pounds pressure of nitrogen per square inch was made on vegetation growing on an airplane bomb revetment of an abandoned wartime airfield. This vegetation consisted of Bermuda grass, Needle grass (Stipa species), Crested Wheat grass, Filaree, Inkweed, Cattle Spinach and Russian Thistle—approximating the vegetation that will be encountered eventually on the slopes of the Friant-Kern Canal along its southern route. The results proved fairly satisfactory, with a partial to complete burn of green vegetation and destruction of 75 percent of the seeds of annual plants.

From the foregoing, the reader has probably formed an idea that the flame thrower is a fairly lethal weed killer. However, there are a number of disadvantages which weigh heavily against this equipment coming into common use as a weed killer. They are:

1. The fuel supply is too limited. Operating pressures of 1,300 to 1,700 pounds per square inch expend the 4 gallon fuel supply contained in the tank in less than 10 seconds. As a result, too much of the operator's time must be spent in recharging and refueling the equipment.

2. Too much of the flame is dissipated upward. The greater part of the flame, traveling 70 to 90 feet in each burst, is lost upward and, therefore, is not effective in killing weeds.

3. The gun, without modification, is too dangerous to operate. Although mechanical operation is simple, the flame thrower is dangerous in untrained hands, necessitating rigid safety precautions and limiting its use to thoroughly trained operators.

(*Continued on page 73*)

Reclamation in Switzerland

Rapid procedure of Switzerland's reclamation program. Background—excavation of main drainage canal; middle—tile drainage; foreground—cultivation of drained land.

by **DR. H. SCHILDKNECHT,**

Federal Institute of Technology, Zurich, Switzerland

Switzerland's agricultural productivity is limited by nature, since half of the total area of the country is unproductive, consisting of woodland, lakes, glaciers, and rocky wastes.

In addition to this, a rather great part of the agriculturally productive land is situated in the mountains where the land is used primarily in an extensive way as pasture.

With this the case, there is only about seven-tenths of an acre of fully productive land for each person in Switzerland. Therefore, it is understandable that under normal conditions, one-fourth of the food supply requirements of the Swiss population must be covered by imports. The importation of food stuffs in peacetime was not difficult. But, the outbreak of World War II altered these relations fundamentally.

Of course, great supplies of food were stored away by the government and private individuals, but this supply would only cover the needs of the country for a short time.

Because of the unfortunate military collapse in France, Switzerland became completely enclosed by the powerful Axis nations, Germany and Italy. The Swiss people, with their democratic feeling, rejected with utmost clarity the political theories of their neighbors. The political relationship between Switzerland and these fascistic states became worse and worse.

It was clear that from no side was help to be expected for the alleviation of pressing food shortage difficulties in the future.

It was feared much more, and with good reason, that a food shortage in Switzerland might be utilized by both of her neighbors in order to effect political pressure.

In the interests of the preservation of independence of the country, one of the most important problems was to make Switzerland less dependent upon imports by increasing the agricultural production within Swiss territory.

Agricultural experts calculated that under the establishment of a strictly administered rationing system, about 1,250,000 acres of arable land were necessary in order to make the country more or less self-sufficient; and at the be-

Typical example of how property holding within a Swiss village is improved and new settlements are created. Shaded areas indicate the consolidation of holdings by three main landowners.

ginning of World War II there were only about 500,000 acres of arable land in Switzerland.

The first step was to plow under a considerable amount of pasture land. It was not the intention to bring about too severe a reduction of pasture land, because that would have had a serious effect on cattle breeding and dairy production. The only possibility of creating additional arable land was through reclamation, by which new land was gained by drainage of swamps, irrigation, and clearing of not too profitable woodland. And in addition to this, it was also necessary to carry out these projects as quickly as possible, so that the land could be made to yield in the shortest time.

The foundation for the realization of this reclamation program was already laid. The Federal government and the cantonal administrations (comparable to State governments in the U. S. A.—Ed.) contained a well organized agricultural engineering service.

Reclamation laws had already been passed and a sufficient number of agricultural engineers, trained in the Swiss Institute of Technology, stood by.

With great speed the necessary drainage canals were built and the adjacent land was tile-drained, so that during the course of the war nearly all swamps disappeared from the landscape.

In spite of the rapid performance of this task, attention was given to careful planning and construction. With the exception of a few failures, which were caused by abnormal soil properties or water conditions, this work continued to full success. These drained areas are today among the richest farm lands of the country.

Although the clearing of forests and conditioning of such land usually lead to high costs, which gave reason for opposition, a far-reaching clearing program was carried out, in spite of all obstacles.

The irrigation of irrigable land was practiced by means of overhead sprinkling equipment. Through the realization of this reclamation program, it was possible during the war to convert 240,000 acres of previously more or less worthless land into good farm land.

But even at that, the work of the agricultural engineers had not yet come to a close. There was a possibility of increasing productivity through the improvement of farming conditions. The main drawback to intensive farming lay in the fragmentation of agricultural property.

Fragments of Property

As a consequence of the old three-fallow system and unwise division of inherited property, the farm land was divided in many farming areas of Switzerland into numerous tiny lots of unusual and irregular shape. According to the agricultural census of the year 1929, an average of 11 lots, each with an average surface of a little more than 1 acre, was the share of each farmer in Switzerland. In addition to this the farmers often live together in villages and their farm land is situated some distance from their homes. Since there is a lack of adequate roadways the farmer is obliged to cross over other property in order to get to his own lots. These rights of trespass are a cause of much crop damage.

In areas with excessive fragmentation of property the utilization of farm machinery was almost impossible and therefore the yield and the profitability of the land was way under par.

These unfavorable farming conditions could only be improved by fundamental changes in property holdings. The old property boundaries have been completely abolished and an attempt has been made to portion out to each farmer the

(Continued on page 76)

Sorghums

by L. M. Sloan, Superintendent, Garden City Agricultural Experiment Station, Branch of Kansas Agricultural Experiment Station, Cooperating with United States Department of Agriculture, Garden City, Kansas.

ALTHOUGH sorghum seeding time was still a few months away, several inquiries for seed supplies were coming across my desk as early as January this year, as well as inquiries regarding certification of seed, storage problems, and methods of irrigation. This off-season activity is proof of the rapidly growing interest, particularly, among operators on irrigated farms, in the already immensely important and popular sorghum crop.

All classes of livestock make efficient use of sorghums in some form, which in turn has helped create a demand for sorghums as cash grain, as well as a feed crop. As dry feed or silage, sorghum roughage contributes much to the beef, dairy, and sheep feeding industries. The sorghum grain when fed to sheep, cattle, hogs, and poultry is about equal to corn in feeding value.

Sudan grass, also a sorghum, has proved its value as a pasture and hay crop.

The sweet (or forage type) sorghums can be grown in most of the States, but the crop as a whole is not adapted to the higher altitudes of the western Mountain States or to the cold temperatures of the New England and northwestern States.

Grain sorghum is most extensively grown in the Southwest in an area approximately 400 miles wide and 1,000 miles long. This region lies in the shape of an oval like a giant egg upon the map, reaching southwestward from Southern Nebraska, across Kansas, including all of Oklahoma and parts of eastern Colorado, Southwestern Missouri, Northeastern New Mexico, and Texas. This area includes the

Combine maize makes harvesting easier. This variety, known as "Martin's Combine Maize" raised on the Salt River project, can be harvested before the frosts. ***Photo by Harry W. Myers, Region III.***

panhandle country of Oklahoma and Texas, one of the most important grain sorghum areas. (See map on inside front cover.)

Outside this oval, except for certain areas in Arizona and California, sorghum is chiefly grown for silage, bundle forage or syrup. The area of adaption, however, is growing larger as a result of an intensive selection and breeding program.

Grain sorghums were first grown in the United States in 1874 when brown and white Durra were introduced to California from Egypt. Two varieties of kafir were brought into the United States in 1876 from South Africa. In 1895 a selection which had been grown in Oklahoma under the name of "black hulled white kafir corn" was grown in Kansas and became the progenitor of the modern black hull kafirs. In 1905, a new kafir later known as "pink kafir" was introduced from Africa.

Milo, a yellow-seeded, highly palatable grain type, was first introduced into the United States about 1880 and was first grown in South Carolina and Georgia. The variety probably came from Africa, but this is not definitely known. Milo was first grown in the Great Plains about 1890. It is this type of sorghum which has provided much of the parent material for the improved grain, and the combine grain types of sorghum now being grown in the Southwest.

Sorghums grow best when the weather is hot and an abundance of soil moisture is present. This makes it a "natural" for the irrigated sections of the Southwest with its deep rich soils and high summer temperatures. Under such conditions forage sorghums, such as the Atlas variety in Kansas, will produce 15 to 20 tons of first class silage per acre, or one of the combine milo types will produce 75 to 100 bushels of grain per acre.

Dr. L. L. Jones and his son Taylor of Garden City, Kans., store upwards of 2,000 tons of sorghum ensilage each year, feeding it during the winter to their herd of purebred Hereford and several hundred feedlot steers. This is only one instance of its wide use as a feed crop in the sorghum belt.

In 1944, a year of above average rainfall in southwest Kansas, thousands of acres of summer-fallowed land on which wheat was not seeded due to a dry fall, were seeded to Westland milo. Yields of 60 to 80 bushels per acre were not uncommon and J. E. Baldwin, ditch superintendent for the farmers' ditch company, reported an actual yield of 120 bushels per acre of Westland milo on his farm which had been drilled in 10-inch rows on irrigated alfalfa ground.

The development of the so-called "combine grain" types which permits the use of combines, with subsequent decrease in labor requirements, represents a considerable advance over the former tall types. These require harvesting with a corn binder and a great deal of hand labor. This reduction in labor and harvesting cost has been the main reason for the rapid increase in popularity of the grain sorghums of the combine type. John B. Seiglinger of Oklahoma was the first of the plant scientists to hybridize and obtain a dwarf (or combine type) grain sorghum. Other plant breeders who have contributed to the industry by producing new and improved strains of combine type milos that are high yielding, resistant to disease, and stiff-stalked are Karper and Quinby of Texas, Swanson, Lowe, and Coles, of Kansas, and several others.

During World War II, industrial needs stimulated by a lack of imported raw materials, revealed new uses for the sorghum grains, as a substitute for tapioca, in the manufacture of industrial alcohol, corn syrup, and several types of starches extensively used for industrial purposes.

Proof of the expanding demand for sorghum grains for industrial purposes is the announcement by a corn products refining company, of its plans to build a giant sorghum grain processing plant at Corpus Christi, Tex. The plant will produce dextrose, starches, and high protein feeds. It will have a grind capacity of 20,000 bushels per day, and company officials promise to have the plant ready for processing the 1948 crop. Other smaller plants are springing up throughout the grain sorghum belt.

Sorghums are particularly well suited to areas where the amount of irrigation water is limited, as maximum yields can be produced with relatively small quantities of water. At the Garden City Branch Experiment Station where the average annual rainfall is around 17 inches it has been found that 12 to 15 inches of irrigation water in a year of average rainfall will produce maximum yields. Most of this irrigating can be done during the winter or between crops, providing the soil is sufficiently deep and of such texture that it will hold large quantities of water. Sorghum roots usually penetrate 5 to 8 feet, therefore there is little danger of loss of irrigation water because of too deep penetration, except in shallow soils.

Sorghums require a moist warm seedbed for best germination. Under such conditions, irrigated sorghums require 6 to 10 pounds of seed, germinating 80 percent or higher. A. E. Lowe, Agronomist at the Garden City Experiment Station, has demonstrated that yields of grain sorghums can be increased up to 75 percent by seeding in rows from 10 to 24 inches apart instead of the conventional 42-inch rows. Unless the land is unusually free from weeds, planting in rows sufficiently wide enough to permit cultivation is preferable to seeding with a grain drill in close spaced rows. When seeded in rows 22 or 24 inches apart, the system will also permit corrugation between the rows for irrigation purposes. Sugar beet seeding and cultivating equipment is ideally suited for planting and cultivating the combine grain varieties when they are to be irrigated.

The grain must be well dried at combining time if heating in storage is to be avoided. Usually 13 percent moisture is considered a safe level. However, if the crop is to be sold and processed immediately, the moisture content may be somewhat higher.

The high yields of sorghums require that the land be enriched frequently with either barnyard manure; commercial fertilizer; by the turning under of a green manure crop, or by the growing of alfalfa or other legume crop. •

Water Worries?

Be sure to get next month's copy of the ERA which will carry a West-Wide forecast of 1948 water supplies. These data will be based on work of the western snow surveyors Paul A. Ewing and R. A. Work. The article will also carry the standard water tabulation showing storage in Reclamation reservoirs.

TOPOGRAPHY and Irrigation Farming

by **W. W. JOHNSTON, Project-Development Supervisor, Columbia Basin Project, Region I**

Draftsman Charles E. Yarwood puts the finishing touches on "before and after" scale relief models at right. Map below shows in detail how Columbia Basin project family-size farms are laid out to conform to physical features of the land. A natural drainage gully forms a boundary for four of the seven farm units, and an irrigation canal around the base of the steep slope in the upper left corner forms a boundary for three farm units. Other boundaries are determined by suitable farm size and by a county road running entirely around the section, thus giving each farm direct access to a highway. The tongue-shaped parcel of land near Yarwood's brush and extending toward the reader represents nonirrigable land. ***Photo by H. Wayne Fuller, Coulee Dam. Drawing by several Columbia Basin employees.***

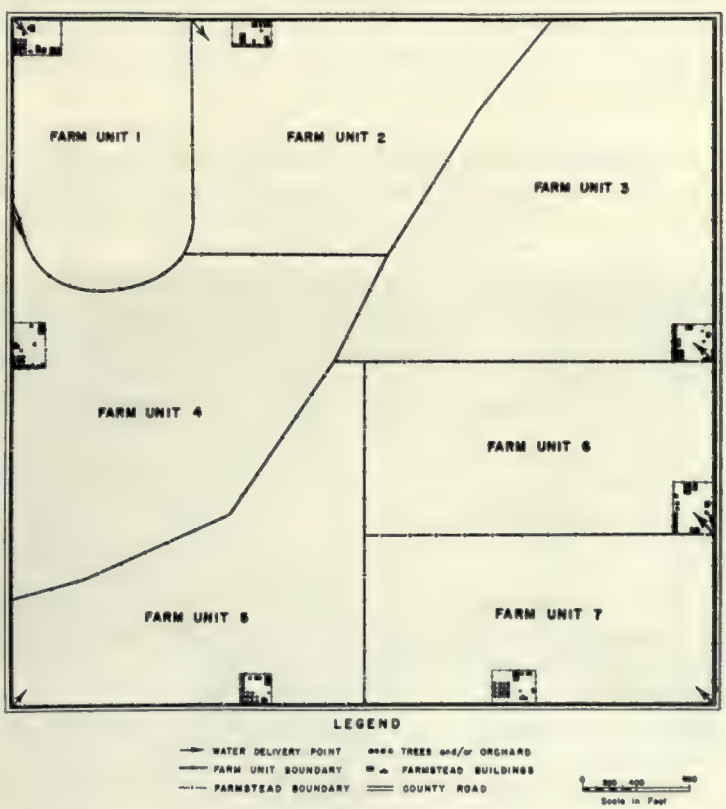
Irrigated farms served by one headgate, free of crossing roads or canals, and requiring only a minimum of expensive flumes and other structures—that is the pattern of farm-unit lay-out on the Columbia Basin project of Eastern Washington.

The Bureau of Reclamation is cooperating with landowners in the project area to avoid many of the difficulties which new settlers on other projects have faced because of farm lay-out based only on conventional survey lines.

The traditionally rectangular farm, with its "forties" and "eighties," is well adapted to irrigation only if the land lies on a regular, uniform slope. But when a farm includes land on each side of a draw, for example, the farmer has severe problems of water distribution. He must build a flume or pipe line across the draw, or else the agency supplying water to him must deliver it from two laterals and through two headgates, one on each side. Under such conditions, transfer of heads of water from one field to another is difficult and expensive.

Over a long period of years, some of these difficulties have been ironed out on the older projects through a gradual process of land purchase, sale, and exchange among owners who have realized the advantages of farm boundaries based on topography. It is a troublesome process, however, once the land is developed and producing under irrigation. As a

(Continued on page 80)



THE HOME with a future

by **HELEN NOYES,**
Extension Economist in Home Management,
The State College of Washington

That bit of advice about a better mousetrap still makes sense. And out in the Columbia Basin project of eastern Washington, a new farm home often is a friendly snare for women who "hope to have something like it some day."

One farm home, in particular, is of exceptional interest to westerners because it is on the first development farm of the Columbia Basin irrigation project and appeals to the eye of every visitor.

We, of the State College of Washington, who participated in the planning of the Moses Lake development farmhouse, believe that this dwelling has many distinctive features designed to meet the needs of any farm family. We do not call it the perfect farm home of the future. Rather, we call it the home *with a future.*

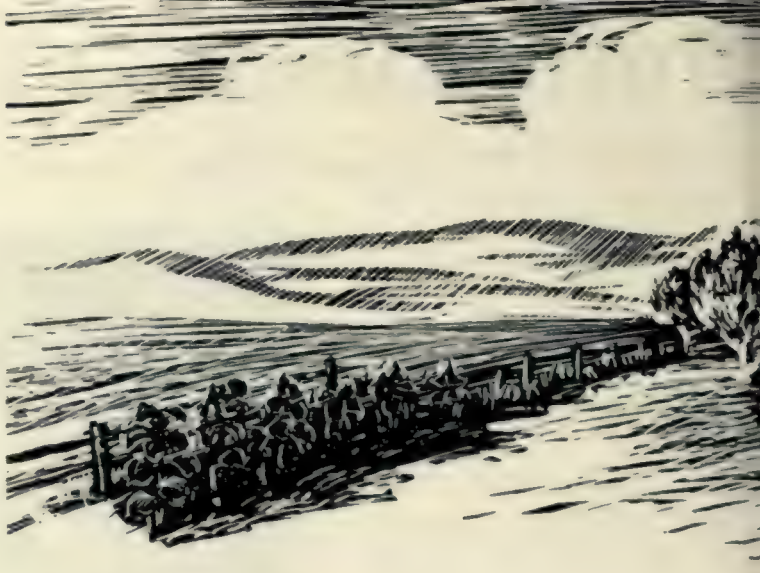
Let us point out its features so you can compare it with your home or that home you are planning.

The Moses Lake development farm home was planned to be built in sections, if necessary. This would permit gradual expansion in keeping with a family's ability to invest more in a dwelling as the farm becomes more productive.

The home has a central hallway opening into every room in the house, thereby keeping family traffic from streaming through the kitchen.

There is a special place for doing the "dirty work" so that the kitchen isn't always upset.

EVERY CONVENIENCE BUILT IN—Mrs. Kenneth Hampton demonstrates the advantages of a 32-inch mixing table at the Moses Lake farm home. Other built-in working space is 38 inches high. ***Photograph by Harold Foss, Region I.***



The front door is placed so it will be used as a front door. It is just off the front driveway—and directly facing it. The front door is also close to the kitchen to make it easy for the homemaker to meet callers.

The rear door opens directly onto the farm court. The house has ample storage space for convenient, comfortable living.

Just as important as these features of good farmhouse planning is the location of the dwelling according to the lay of the land, the direction of the prevailing winds, and the farm buildings. The Moses Lake house is so located that the prevailing winds blow from the house toward the farm buildings. With regard to the lay of the land, the house is located so water will drain away from it.

The home itself is a basic, two-bedroom house with a full basement. In addition to the bedrooms, it has a large living room, a combined kitchen and dining area, and a bath. A coat closet is near the front door, and a workclothes closet is right by the rear door. The main-floor bath is also near the rear door. Each bedroom has a large wardrobe closet. The house has a linen closet at the end of the central hallway between the two bedrooms.

The hallway contains much of the home's storage space and its 4-foot width allows room for large objects to be carried through it. The door to the basement is also in the hall and so is the clothes chute which empties into the laundryroom in the basement.

All closets are designed in keeping with the articles to be stored and there is a proper niche for everything from sheets and towels to brooms, bedding, and school books.

The U-type kitchen adjoins the dining area, but is out of the way, in case the family wants to use the dining table for studying, or for working with farm accounts. Kitchen built-in features provide two working heights. The sink is 38 inches high and the mixing table, 32 inches. A built-in lapboard permits the housewife to sit down while she works.

Mrs. Kenneth Hampton, whose ex-service husband operates the farm for the Bureau of Reclamation, says she is especially partial to the 32-inch working height of the mixing table.

Another of the home's favorite features, as far as Mrs. Hampton is concerned, is the arrangement of the stationary

tubs in the basement. They are set out two feet from the wall and permit Mrs. Hampton to work on any side or at any angle she choses. Other laundry equipment includes a built-in water heater, sorting table, built-in shelves for supplies, and adjustable drying lines. The laundry also is used as a general utility room.

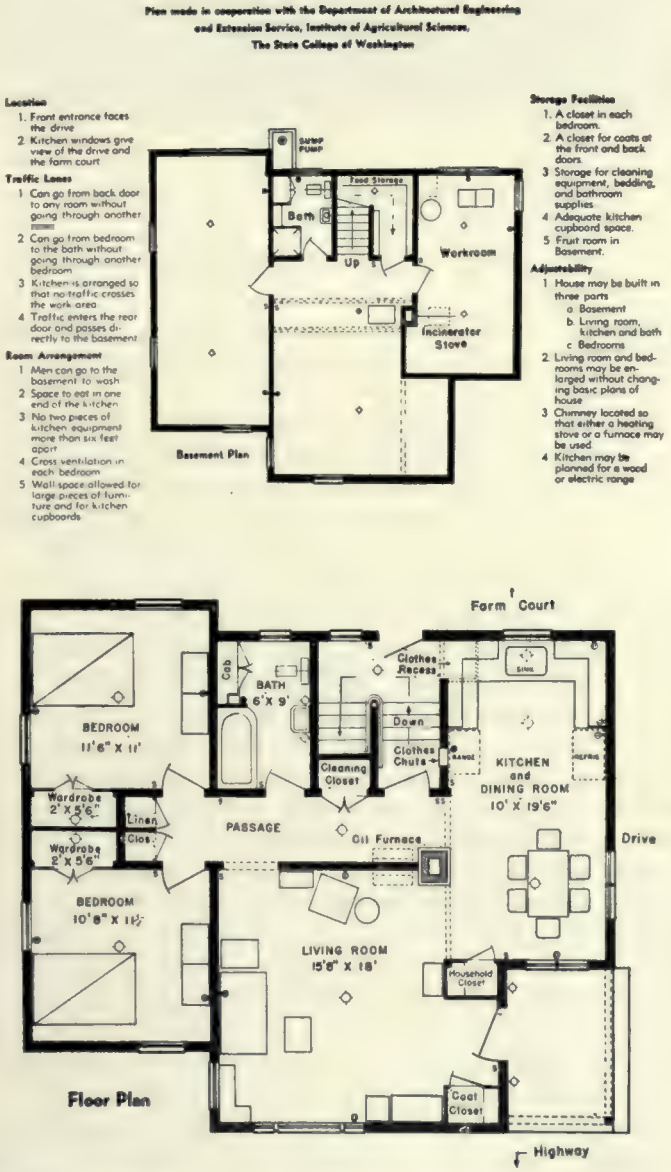
A fruit room, the furnace, and a shower-bath are also in the basement. The fruit room has a ventilator and ample storage space. Shelves are designed to hold two rows each of pint and quart jars.

To see the house certainly is a welcome sight after miles of sagebrush. It is difficult to believe it was only a blueprint a few months ago.

The planning process really got under way back in 1946. That was when the Bureau of Reclamation asked the Extension Service for assistance in working out a building plan for the development farm home. The request, naturally, was warmly received because it fitted in with our rural housing program and offered an opportunity to help demonstrate some of the principles of good farmhouse planning, especially to the people moving into the Columbia Basin. When this project is fully developed it will have more than 16,000 farm homes.

The building plan for the Moses Lake home represents the combined ideas of college staff members at the State College of Washington and members of the project development staff of the Bureau of Reclamation. The college contribution was made by a housing council headed by Stanley A. Smith of the Department of Architectural Engineering. Other departments of the college represented included agricultural engineering, mechanical engineering, home economics, and the Extension Service. The Extension specialists carried the ball back and forth from the housing council to the Bureau, acting in our usual capacity as traveling representatives of the College. And although the round-trip distance to be covered was some 280 miles, only 3 or 4 months were required to develop the plan.

Scale drawings of the floor plan of the Moses Lake house are shown in Extension Circular 113, which is available from the State College of Washington Extension Service, Pullman, Wash. •


Plan made in cooperation with the Department of Architectural Engineering and Extension Service, Institute of Agricultural Sciences, The State College of Washington
Location
1. Front entrance faces the drive
2. Kitchen windows give view of the drive and the farm court
Traffic Lanes
1. Can go from back door to any room without going through another room
2. Can go from bedroom to the bath without going through another bedroom
3. Kitchen is arranged so that no traffic crosses the work area
4. Traffic enters the rear door and passes directly to the basement
Room Arrangement
1. Men can go to the basement to wash
2. Space to eat in one end of the kitchen
3. No two pieces of kitchen equipment more than six feet apart
4. Cross ventilation in each bedroom
5. Wall space allowed for large pieces of furniture and for kitchen cupboards
SUMP PUMP
Bath
Food Storage
Up
Workroom
Incinerator Stove
Basement Plan
Storage Facilities
1. A closet in each bedroom.
2. A closet for coats at the front and back doors.
3. Storage for cleaning equipment, bedding, and bathroom supplies.
4. Adequate kitchen cupboard space.
5. Fruit room in Basement.
Adjustability
1. House may be built in three parts
a. Basement
b. Living room, kitchen and bath
c. Bedrooms
2. Living room and bedrooms may be enlarged without changing basic plans of house
3. Chimney located so that either a heating stove or a furnace may be used
4. Kitchen may be planned for a wood or electric range
Farm Court
Clothes Recess
Sink
Cab
BATH 6'X 9'
Down
Clothes Chute
BEDROOM 11'6" X 11'
Cleaning Closet
KITCHEN and DINING ROOM 10' X 19'6"
Range
Refrig.
Wardrobe 2'X5'6"
Linen Clos.
PASSAGE
Oil Furnace
Drive
Wardrobe 2'X5'6"
BEDROOM 10'8" X 11½'
LIVING ROOM 15'6" X 18'
Household Closet
Coat Closet
Floor Plan
Highway

ROOM FOR EXPANSION—Above, basement plan of Moses Lake Development Farm House, and, below, floor plan, showing the nucleus of a modern home with a future. ***From Extension Circular 113, the State College of Washington.***

A CORN KING in wheat country

MODERN FARMING—On the Verhage farm, corn is a crop that lends itself completely to mechanization. It is power-produced—from seed-bed preparation on through listing, cultivation, fertilization, irrigation, and harvest. Even in dry, hot 1947, parts of the field of K2234 white hybrid beat 100 bushels to the acre, averaging around 66 bushels. The yellow corn was nearly as good.

by **ROSE S. FLOREA**

OUT in the greatest wheat-producing state in the Union, a Kansas flying farmer took a flyer in corn and struck it rich.

He is Bas Verhage, near Downs in Osborne County, who first became a member of the 100-Bushel-Club in 1946 with a whopping yield of 102.71 bushels per acre. Just to show that it wasn't pure luck, Mr. Verhage duplicated the 100-bushel-plus yield in 1947, an extremely droughty year.

"Why did I try corn in this dry, wheat country?" asks Verhage. "Well, most of us farmers agree that this good, rich bottom land like mine is right for corn—if we can just have water in July and August. With the Solomon River near my field, I decided to take a try at supplying the moisture. And besides," continued Verhage, "if you've got water, corn's the better bet for a crop, even in this great wheat country."

Irrigation, plus good cultivation, is awfully good insurance, the way this Kansas farmer figures.

Mr. Verhage has gone strong for the Kansas-developed white hybrid (K2234) the past 3 years. "You know," he remarked, "white corn has come up in price the past few years. And this particular variety yields as well as any I've tried. What's more, it holds its ears well and you can pick it with a machine. Some of the yellow varieties drop their ears. In fact, I've found none that hold the ears like the Kansas white."

Verhage uses power machinery in listing, cultivating, and picking his corn. "I cultivate twice," he explains. "Like to blank list my fields early in the spring; then split the ridges when planting. Of course, I use a stalk cutter and disk before the blank listing. I don't rake and burn any stalks, so I have a pretty heavy growth to work into the soil."

To irrigate his corn, Verhage uses two pumping plants. A 6-inch pump irrigates a 31-acre field and an 8-inch pump furnishes water for another 90-acre tract.

In describing his equipment, Verhage said: "The small pump throws about 1,300 gallons a minute; the larger one 2,000 a minute. I usually irrigate twice. It amounts to around 15 inches of water. I aim to start the water at least a week before the corn shows any serious need of moisture. That's usually before the middle of July—about the time it is ready to tassel."

Not only does this successful corn grower water his corn, but he feeds it, too. He applies a 33 percent ammonium nitrate fertilizer at the rate of 125–150 pounds per acre. He puts this on either at the last cultivation, using an attachment on his cultivator, or adds it to the water at tasseling time.

Verhage expressed complete satisfaction with his corn project although he admitted that he and his family spent most of 5 weeks irrigating to produce the bumper 1946 corn crop. The average annual rainfall for that area is only 20 inches.

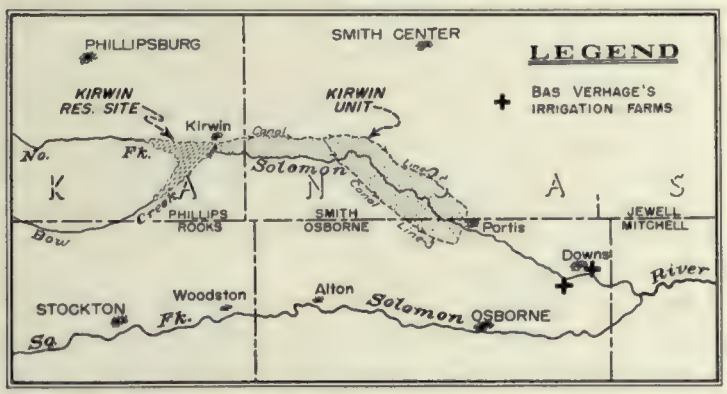
"It cost me around $5 an acre to irrigate that crop," Verhage figured. "But you've got to have the water to get corn. Take my dryland field! We had about 60 acres farmed by a tenant. It didn't do so well. Sold about half of it for silage at eleven bucks per acre. The other half made from 20 to 40 bushels. Some of it was down on the river bottom which now and then gets overflow from the river."

Since Verhage started his irrigation project in 1938, 15 other farmers in that vicinity have invested in pumping plants. Two years ago this group produced a total of 20,000 bushels of corn. Verhage said he'd hate to guess how many bushels of corn they would have had around Downs without irrigation—less than 5,000 bushels, maybe not even 2,000.

Verhage belongs to the Kansas Flying Farmers and pilots his own small plane. Active in community work, he is president of the local school board, and participates in activities of the American Legion Post and Business Men's Club. •

Reprinted from The Furrow, January–February 1948 issue, with the kind permission of the author, Rose Florea, and the publishers, Deere & Co. of Moline, Ill.

Irrigation has a bright future in Kansas based on Mr. Verhage's experiences as described in the article "A Corn King in Wheat Country." Mr. Verhage's farm is located by the North Fork of the Solomon River about 8 miles east of the lands of the authorized Kirwin, Kans., irrigation and flood control project. The reservoir site of the Kirwin project is located at the village of Kirwin, Kans., in southwestern Phillips County. The project lands to be irrigated are in the valley of the North Fork of the Solomon River in Phillips, Smith, and Osborne Counties between Kirwin and Portis. Like Mr. Verhage's land, the Kirwin project area is a fertile valley of bottom and terrace land that is suitable for irrigation development. It can be expected that many irrigators under the Kirwin project will be able to report large crop yields, similar to those of Mr. Verhage, after the dam and distribution works are constructed and water applied to the land. Other Kansas irrigation projects now authorized as units of the Missouri River Basin project also will make possible the production of high crop yields after the reservoirs and distribution systems are constructed and in operation.



Flame Throwers versus Weeds

(Continued from page 64)

4. The cost is too high. The combined cost of fuel and nitrogen gas at no time in the trials fell below 37 cents per hundred square feet of area burned, even when free crankcase drainings were used as fuel. By comparison, many conventional type weed burners operate at a cost of not more than 6 cents per hundred square feet of area burned.

On the other side of the picture there are a number of advantages in operation of the flame thrower which should not be overlooked:

1. It is portable. The equipment, with its reach of 70 to 90 feet, plus its portability, can perhaps burn areas not accessible to heavy weed burning apparatus.

2. It is durable. No time was lost during any of the trials because of malfunction. A minimum of time is necessary for adjustment, lubrication, and other maintenance work.

3. There is no danger of "blowback." The positive fuel shut-off valve guarantees cutting off the fuel as soon as pressure is released from the pistol-grip type valve, thus preventing the possibility of dangerous "blowback" of the flame.

Realizing that definite possibilities existed in the gun itself, the Bureau asked the Buena Vista Water Storage District burning crew to use the gun assembly attached to its regular diesel oil spray rig in normal burning operations, keeping a record of fuel consumption, coverage, range, ease of operation, mechanical stamina, and general suitability to canal bank burning operations.

The burner rig in use by the District had been operated with an ordinary orchard-type spray gun. Lack of a suitable cut-off valve had resulted in destruction of three rigs due to "blowback." Introduction of the flame thrower gun to their 400 gallon capacity weed burner was a distinct improvement as there was no "blowback," the fuel cut-off being positive and fast. The operator, a veteran of 5 years of weed burning, was heard to remark that it was the "best dern burner" he had ever used. Further questioning, however, brought out that during the 80 hours of operation the air compressor could not maintain adequate pressures for efficient burning. Operating costs, including labor and fuel, were much higher than with the ordinary sprayer gun as it took more fuel and more time to burn a specific area. It was apparent that the flame thrower gun needed to be modified before it could be used successfully in weed burning operations.

The correction was made by placing a brass ring on the external face of the original orifice thus reducing the diameter from five-sixteenths to seven thirty-seconds of an inch. With this modification, the gun maintained a constant pressure of 250 pounds per square inch, and the operating range of burning was increased from an erratic maximum range of 35 feet to a uniform maximum of 60 feet. The daily fuel consumption of the burning rig, using the modified flame thrower gun, was reduced from 1,100 gallons of diesel oil to 850 gallons per 8-hour day. Savings in fuel costs per day at 7 cents per gallon for diesel oil amounted to $17.50. The increased coverage and thoroughness of burn because of the much improved range permitted more rapid and economical coverage.

Experience with the gun by the Buena Vista Water Storage District has shown the need for an additional modification to make the flame thrower gun more applicable to use on weed burning equipment. The present spring is so strong that the operator's hands tire quickly while holding the gun in open position during burning operations. It is recommended that a spring of less strength be substituted in using the gun with conventional weed burning equipment.

As a result of these various investigations, an Ex-Marine and an ex-doughboy recommended that the United States Army flame thrower continue to be used for its original purpose of destroying the enemy in caves and pillboxes, but they do not recommend it as a single unit for destroying weeds.

However, the gun, which looks like an Army version of Buck Rogers' weapon, has definite possibilities—if it is used along with conventional weed burning equipment. •

Two of the Bureau's engineers, R. F. Blanks, Chief of the Division of Research and Geology, and H. S. Meissner, Head, Basic Concrete Research Section of the laboratories, were recently awarded the Thomas Fitch Rowland Prize of the American Society of Civil Engineers for a paper entitled "Deterioration of Concrete Dams Due to Alkali-Aggregate Reaction." (See last month's issue of the Era.) In this paper they describe numerous cases where cracking has been diagnosed and related to reaction between cement and aggregate. Here is a brief resumé of the subject, written especially for the Reclamation Era by one of the prize winners.

EXPANSIVE CRACKING IN CONCRETE

by **H. S. MEISSNER,**

Head, Basic Concrete Research Section, Division of Research and Geology,
Office of the Chief Engineer, Denver, Colo.

Every chemist, or cook, knows what happens when the wrong combination is made of the right ingredients, or the wrong ingredients are put together in the right combination.

So it is with concrete. The photograph in the upper right-hand corner illustrates what is known as "random-pattern" cracking caused by too much expansion in concrete.

The condition shown was due to the wrong combination—or "incompatibility"—between the aggregate (sand and gravel) and the cement used. Similar cracking, in some instances, has been related to unsoundness in the cement, or in the aggregate itself. In all such cases, the tell-tale evidence has been the "growing" or expansion of the concrete.

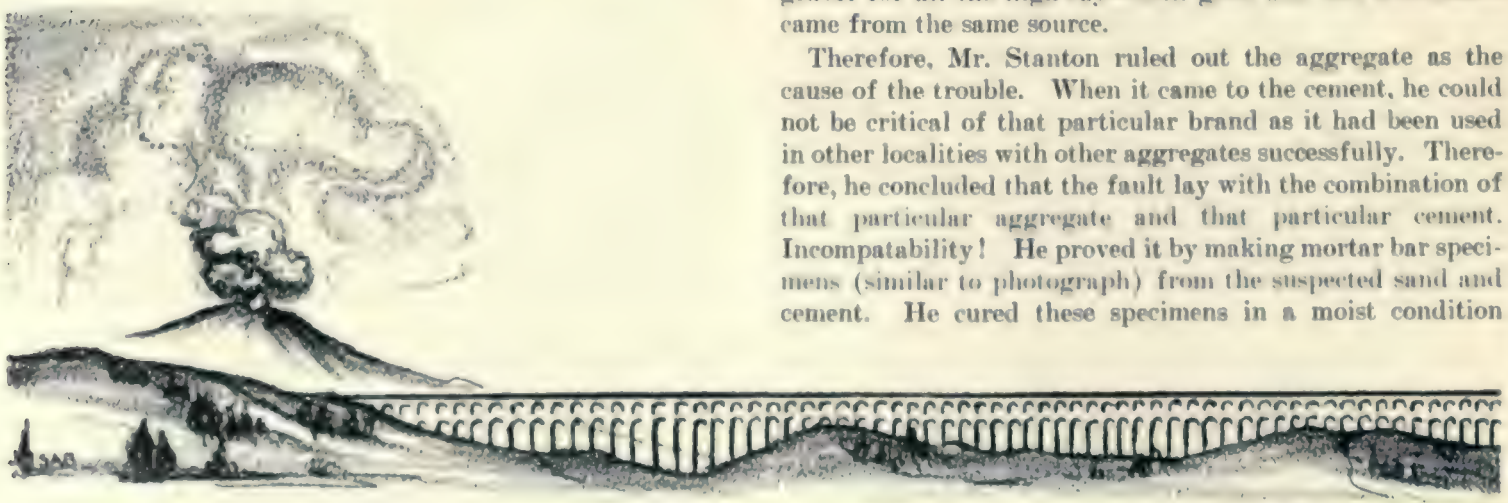
Fortunately, only a small proportion of manufactured concrete has been afflicted with this trouble, but the Bureau of Reclamation is taking steps to avoid it entirely in future work. Engineers in the laboratories of the Chief Engineer's office at Denver, Colo., are studying the causes of such deterioration and have devised methods of preventing it.

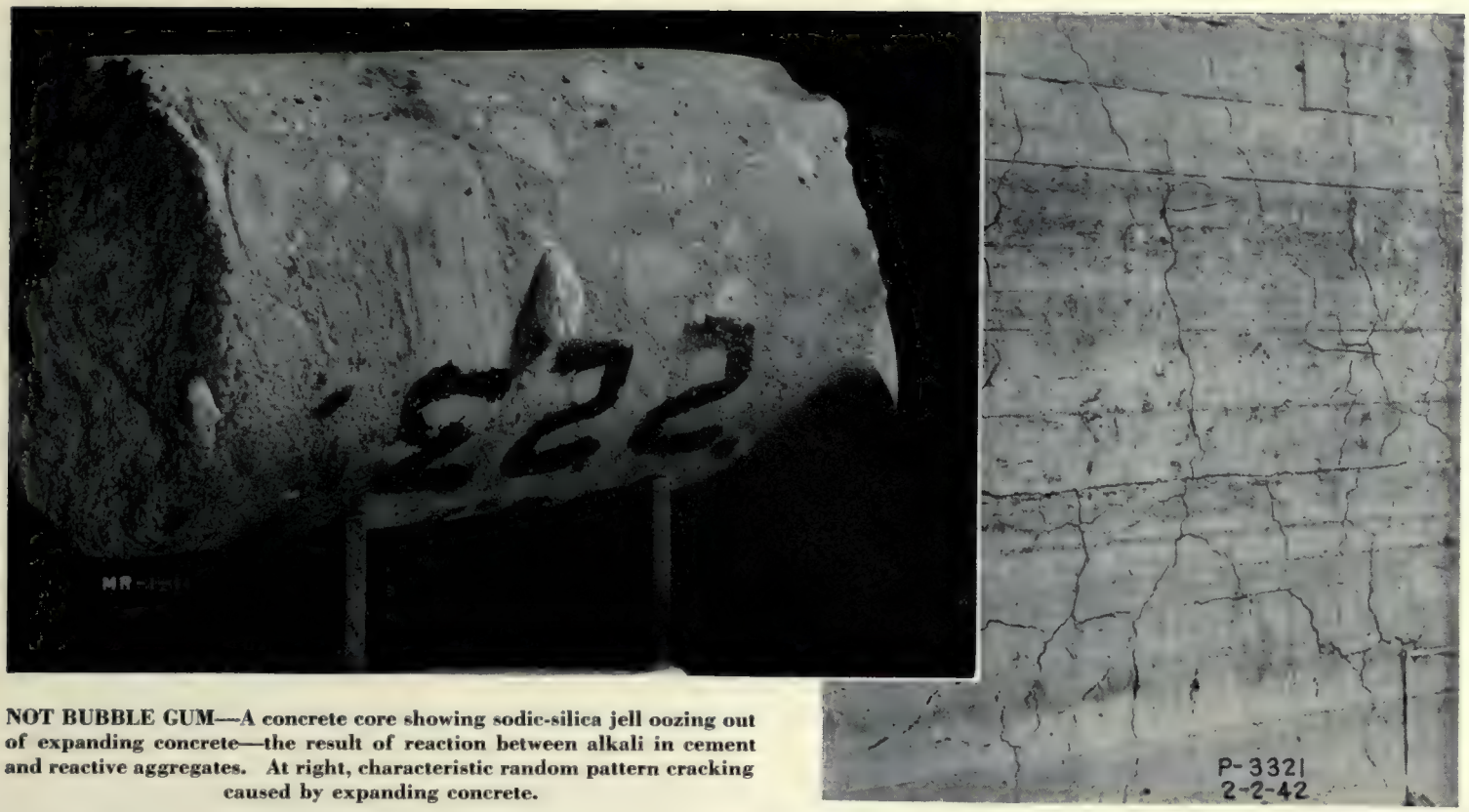
The Bureau's interest in this question arose when, 2 years after its completion, the concrete in Parker Dam (on the Colorado River between Arizona and California) began to crack. Instruments (known as expansion meters) were attached to the concrete and established conclusively that the concrete was swelling, or growing. Although this growth was slight, it was sufficient to stretch the concrete's non-growing, dry, outer skin and crack it.

Before this condition had been observed at Parker, Mr. Thomas E. Stanton, Materials Engineer for the California Department of Highways, had reported a case of expanding concrete, which he ascribed to the use of aggregates which reacted chemically to cement with a high alkali content. Bureau engineers believed his findings would throw light on the Parker Dam trouble because they knew the cements used in that structure were high in alkalies. When they analyzed the slow reaction between some mineral substances in the aggregate and the high-alkali cement used in the concrete, they found that this was the cause of the growing, expanding, and cracking concrete.

Mr. Stanton had noticed that certain stretches of a concrete road, built in California, were cracking and buckling at the expansion joints. Not all of the highway was affected—only those portions where a particular brand of cement had been used showed this condition. The sand and gravel for all the highway—both good and bad stretches—came from the same source.

Therefore, Mr. Stanton ruled out the aggregate as the cause of the trouble. When it came to the cement, he could not be critical of that particular brand as it had been used in other localities with other aggregates successfully. Therefore, he concluded that the fault lay with the combination of that particular aggregate and that particular cement. Incompatability! He proved it by making mortar bar specimens (similar to photograph) from the suspected sand and cement. He cured these specimens in a moist condition





NOT BUBBLE GUM—A concrete core showing sodic-silica jell oozing out of expanding concrete—the result of reaction between alkali in cement and reactive aggregates. At right, characteristic random pattern cracking caused by expanding concrete.

within closed metal containers and found that after a short period of time, sure enough, they expanded. In comparing the suspected cement with other brands, Mr. Stanton found its distinguishing characteristic to be a high content of alkalies, sodium oxide and potassium oxide. And when the aggregate was studied, it was found that it contained a small amount of the mineral, opal, which was chemically reactive with the high-alkali cement.

Reaction between aggregate and cement which causes expansion in concrete is now one of the major research problems in the Bureau's laboratories. Aggregates used in affected concrete are being investigated. Experiments are made on various pure minerals and rock types used as aggregates. In addition to the ill-fated opal, acid volcanic rocks, silicate glasses, chalcedony, tridymite, and some phyllites have been identified as minerals and rocks which are reactive to alkali. Experienced technicians, known as petrographers, can recognize these minerals easily, and now make routine examinations of all prospective sand and gravel to detect such potential troublemakers. Bureau technicians also give them try-outs in various combinations with high-alkali cement, to see if the aggregates can make the grade as sound mortar and concrete, or whether they are "expansionists."

Ordinarily, before the Parker Dam experience, it was not customary to analyze portland cement for its alkali content. The alkalies, sodium and potassium oxides, were considered as minor constituents. If alkali was present in cement, the small quantity was felt to be insignificant. However, some of the brands of cement used in Parker Dam were found to contain up to 1.42 percent sodium oxide. This is now recognized as an inordinate quantity and the Bureau is insisting that cement delivered to its projects (particularly where reactive materials are known or suspected to exist in the aggregates) contain no more than 0.60 percent alkalies. At present, this is considered the irreducible minimum.

As information on this subject has accumulated, it has been found that some pozzolanic materials, added to the concrete mix, will reduce or prevent the expansion between reactive combinations of aggregate and cement. Proof of the lasting qualities of concrete containing such materials has been found in the ruins of certain Roman aqueducts.

Present-day engineers marvel at the fact that these structures were not made of masonry, but of a concrete which has withstood centuries of use and abuse. The secret of their success seems to lie in the use of pozzolans—fine active siliceous materials. In the case of the ancient Roman concrete mixers, they used ash from the lava flow of volcanos. (Editor's note: An extremely reliable source informs us that the word "pozzolanic" has several spellings, due to its evolution through various Italian, German, French and English translations. The word is derived from the name of the town of Pozzoli, Italy, where Vesuvius-erupted pozzolanic materials presumably originated.)

Pumicite, calcined (burned) shale or clay, and fly ash (from burning pulverized coal) are other pozzolans which work in compatible combination with the lime in portland cement, giving the concrete added strength. A calcined diatomaceous (finely powdered) shale is now being used in the concrete for Davis Dam, which is being built upstream from Parker Dam. At the Davis site, unfortunately, the aggregates available for concrete work contain reactive aggregates.

Who knows? Perhaps the pozzolanic materials used in the Davis Dam structure will make the concrete as impervious to time as the Roman aqueducts. •

Reclamation in Switzerland

(Continued from page 66)

total amount of his previous property holding in one single lot. New settlements have been created by buying up a large number of small parcels of land. The necessary homes and farm buildings for family-sized holdings have been built. It is clear too, that with the redistribution of land a network of roadways had to be planned, so that each farmer could get to his land directly.

The best proof for the necessity of this concentration of property is the fact that the farmers never wish to return to the old conditions, when they see the advantages of the new system in increased output.

The benefit of such a consolidation lies in the fact that the farmer is able to save time and to use farm machinery. During the war more than 300,000 acres of land were improved through reparcelment, and an increase of food production was the result.

Simplified Laws Aided Program

In order to expedite the complete reclamation program the previous reclamation laws were amended and simplified. The original basic reclamation law specified that reclamation of land can be effected only if two-thirds of the property holders, representing at least half of the total area of the reclamation district, consented.

Several cantons improved this law so that only a one-half majority of the property holders was sufficient for reclamation procedures to begin. Even if the prescribed majority of property holders did not consent, it was in the power of Federal or cantonal legislature to decree that reclamation take place. But this last prerogative was never exercised, because the necessity of reclamation was obvious in itself.

Unrestricted fulfilment of this program was made possible due to the fact that the customary appeal to the courts was denied. All legal cases were brought before special commissions of appeal.

The planning was done by agricultural engineering offices of the cantons and by private agricultural engineers. The reclamation office of the Federal government had the single obligation of approving proposed projects and of auditing the accounts. Through an extensive standardization of planning, the final approval of the project was greatly simplified and speeded up.

In spite of the shortages in labor and material, reclamation work proceeded with little delay. Since a great part of the Swiss workingmen were in military service, there were considerable difficulties in obtaining a labor force. This state of affairs was overcome by granting leaves of absence for reclamation workers, by the introduction of a labor draft, and the institution of additional compensations for the workers.

Thanks to a well functioning rationing system for coal and other fuels, and the priority given to reclamation work, clay and cement tile, as well as fuel for the construction machinery were made available in spite of their shortage.

Since the reclamation program was considered to be one of the most important factors of national defense, the Federal government and the cantons granted substantial subsidies. These contributions did not have to be paid back. The subsidies of the Federal government ranged from 30 to 50 percent of the total costs, according to the type of reclamation.

In cantons, which could not sufficiently finance such undertakings, subsidies were raised to the level of 60 percent. Only after the canton had granted a subsidy, could the Federal government grant an additional subsidy. The subsidies of the cantons varied from 15 to 40 percent. It is estimated therefore, that an average of two-thirds of the construction costs was paid for by public funds.

Furthermore the whole banking system lightened the load of the reclamation districts by granting loans at a very low interest rate. In order to reduce the burden of interest, part-payments were made on the subsidies by the Federal government and the cantons.

The costs of reclamation work were relatively great, since a high standard was maintained in all planning and construction. *Swiss agricultural engineers and farmers together are convinced that long endurance and low maintenance costs of reclamation works, particularly that of tile drainage, can only be attained if the projects are carried out carefully and built permanently.* The average costs of tile-drainage, inclusive of canals, was 330 dollars per acre; and for overhead sprinkling systems 170 dollars per acre.

The total cost of the entire reclamation program during World War II came to approximately 138 million dollars. One can gain a better conception of the magnitude of the program by referring to the statistics given below:

Cost per capita of the Swiss population	$32
Cost per capita of the agricultural population	159
Cost per acre of total agriculturally productive land	26

The cultivation of this reclaimed land was given the utmost attention. A law stipulated that any private business with 50 or more laborers or office workers would be responsible for cultivating land. The businesses joined together in farming associations, headed by agricultural experts, and had to finance the cultivation of newly reclaimed land.

Competition Helped Production

Competition between the different farming associations sprang up because a part of the food produced was turned over to the workers of the business enterprises in addition to their normal food ration. Because of this added incentive, greater yields were the natural result.

At the end of World War II the reclaimed land could be turned over to the original owners in excellent condition, thoroughly worked and well fertilized.

There was another law by which the young people of the cities were to work on the farms for a short period each year. This had good results in that the city population gained a better understanding of agriculture in general and reclamation in particular.

The Swiss reclamation program during World War II is a good example of how the farmer and agricultural engineer can work together to make a country quite self-supporting, even when faced by adverse agricultural conditions. •

The Water Goes Underground

by **W. H. FARMER**
Yakima Project, Wash., Region I

Alvin Brandt regulating a valve on an underground pipeline at a stilling basin on the Garrett Schilperoot farm 5 miles north of Sunnyside, Wash. ***Photo by Stanley Rasmussen, Region I.***

Gone are many of the wasteful water distribution methods of the early pioneer when water was plentiful.

In the Yakima Valley in the State of Washington, the open ditch is becoming a thing of the past along with the horse and buggy and the Model T Ford. It is now estimated that six out of every ten irrigated farms in this highly diversified crop-producing area have some pipeline deliveries for their irrigation systems and, in some cases, the entire system is under pipe.

The shift from open ditches to pipelines on farms has been taking place at an ever-increasing rate. Reasons for this change are many. The principal advantage gained is that several thousand feet of winding open ditches are eliminated on the average 60-acre farm by the use of underground pipeline. Also efficient use can be made of modern machinery because fields are not cut up into short runs by ditches. Furthermore, the yearly maintenance of open ditches is eliminated and ditchbank weeds are no longer a problem. Water transportation wastes are reduced to a minimum and the water is under control at all times. The cost of water and labor are both materially reduced.

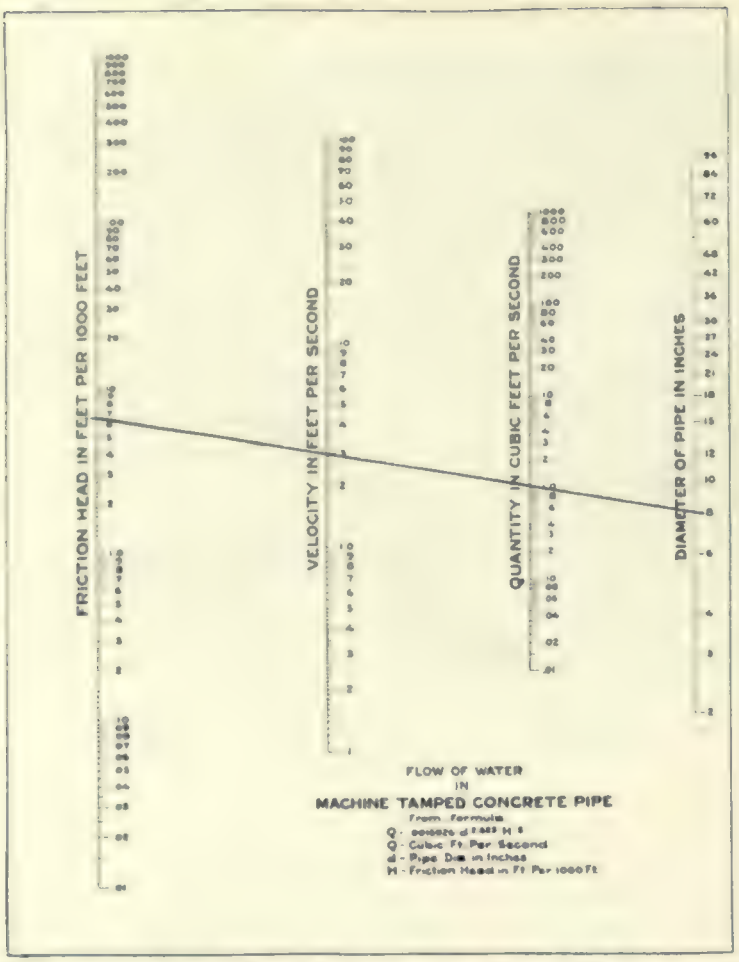
Most underground pipelines in the valley are made of concrete. The method of installing the pipe is extremely important to the permanence of any line. A cover of at least 18 inches of soil over the pipe is necessary to prevent frost damage in the Yakima Valley area and to avoid breakage by cultivation machinery. In areas where the climatic conditions are more severe, pipelines are installed at a greater depth. Under usual conditions a properly installed pipeline is permanent. Tests by the Bureau of Standards have shown that there are no areas here where there is alkali of sufficiently harmful quality or high concentration to injure good concrete pipe.

Very careful attention is given to the grade on which a pipeline is installed. This is a point quite often missed by farmers attempting to install their own lines on too flat a grade. Most engineers and irrigation specialists on pipeline layouts first determine the grade or fall available, so they can properly determine the size of pipe necessary for delivering water to a given acreage. Valley streams carry some sediment material so water traveling at a rate of less than two feet per second will usually deposit silt and sand in low spots along the pipeline, thus reducing the carrying capacity. Sharp breaks in the line grade are avoided wherever possible to prevent siltation and trapped air pockets. In traversing undulating topography, the pipeline is placed on a uniform grade.

Where sediment is a problem, a settling basin is installed at the intake of the pipeline. Weeds and other debris are eliminated by a trash rack and weed screens at the intake. An air vent is installed at the first joint below the intake to free air trapped by the water as it rushes into the pipeline.

The proper size of pipe to use is determined from the accompanying chart. For example, run a straight edge from the figure 6.5 in the first column, showing the grade or fall per 1,000 feet of lineal distance, to the figure 1 in the third column showing the per-second flow required. Then the fourth column on the graph shows the diameter of the pipe should be 8 inches and the second column shows that the velocity of flow in the pipeline would be 3 feet per second. By shifting the straight edge downward to the 6 inch diameter pipe, it is apparent that only one-half of the required quantity of water would be obtained with the same fall of 6.5 feet per 1000 feet. (See chart on next page.)

Experience has taught the farmer and the commercial pipe layer to do the following in laying pipelines.


FRICTION HEAD IN FEET PER 1000 FEET
VELOCITY IN FEET PER SECOND
QUANTITY IN CUBIC FEET PER SECOND
DIAMETER OF PIPE IN INCHES
FLOW OF WATER
IN
MACHINE TAMPED CONCRETE PIPE
From Formula
Q - Cubic Ft. Per Second
d - Pipe Dia. in Inches
H - Friction Head in Ft. Per 1000 Ft

Use a straight edge to figure the proper size of pipe. ***Chart prepared by Engineering Department of Oregon State College.***

- He digs the trench wide enough in the bottom to work in. This means a trench bottom width of at least 24 inches when installing an 8-inch pipe.
- He carefully finishes the bottom of the trench to grade so the pipeline will be firm and, therefore, no settling will take place later.
- He lays concrete pipe in a moist trench, but not in standing water.
- He gets a high strength quick-setting cement and mixes a mortar of one part of cement to two parts sand.
- He covers the collars with moist earth immediately after constructing them. If the earth is flour-like or dry, he places a strip of cement sacking paper over the fresh collars before covering them.
- He leaves 3 to 4 inches of earth over the pipe at least 48 hours before completely backfilling the line.
- He never tests the line by running water through it until after it has been completely backfilled. Usually when a head of water is run through a concrete pipeline that is laying uncovered, the sudden temperature change causes a contraction and results in cracked collars or pipe.

Excessive internal pressure is often the cause of fracture in steel, wood, plastic composition, and concrete pipe. Where excessive pressure is likely, the proposed line is surveyed, and the hydraulic pressure is determined before obtaining the pipe. The correct size and the shell thickness or reinforcement for the line can then be determined, and the system properly designed. Where a pipe line is installed through swales or valleys, thus effecting an inverted siphon, the proper placement of air vents has been found to be necessary. Two types of vents, the standpipe and the automatic valve are used in the Yakima Valley. The standpipe is one size smaller than the pipe line and extends vertically to a sufficient height to carry the static head in the pipe at that point. Where the pressure is great enough to make the standpipe impractical, an automatic valve is installed. Air vents are also installed to reduce the harmful effects of water hammer or surge in the lines when the flow is suddenly retarded by control valves.

Risers and valves are installed along the pipe line for water deliveries to fields. These valves serve from one to several corrugations, furrows, or borders, depending upon their size and make. Where deliveries are made from pipe lines running down steep slopes, other valves are often installed within the pipe line to equalize pressure and allow for equal water distribution to each row.

Drain and flushing valves are always installed at the end of the pipe line and usually at the bottom of large swales to remove sediment at intervals during the irrigation season, and to make certain that no water remains in the lines over winter.

Costs of farm pipe-line installations average $30 to $40 per acre, but may vary considerably from those figures, depending upon topography, pressure heads, size and shape of fields, the number of water-control devices, and irrigation methods required.

It should be made clear at this point that some valley land does not have sufficient slope to install pipe lines unless booster pumps are used. Where gradients are too flat for pipe lines, but not flat enough to prevent erosion in open ditches, flumes may be installed.

Irrigation farmers are receiving technical assistance in their pipe-line lay-outs from the State Extension Service, the Bureau of Reclamation, the Soil Conservation Service, and pipe manufacturers in the Yakima Valley. •

(The writer thanks Mr. E. Ellis Cummins of the Yakima Cement Products Company for the assistance given him in the preparation of this article.)

LETTERS (*continued from page 2 of cover*)

these days. I picked up a conversation with the engineer in charge. He said that due to failure of their ditch digging machine he had to lay off several men the day before. Further conversation revealed that this particular engineer has taken no annual leave for more than 2 years. An employee, more interested in the work he was doing, than his personal pleasure and recreation. I thought this wonderful in times like these.

Laborers are slowing up and doing less and demanding more and more through their leaders. . . . If all of the people in this grand country of ours would just work with determination of purpose, self discipline, and efficiency, so evident in your men working on that Gila project, these times would not be as hard as they are.

Mr. Gollenon, (J. C.) there answered all of our questions about the project, and then some, as did also the two girls in the office. Even the watchman at the gate was friendly and helpful as a man could be. We have seen so many who weren't.

The people of this country should be congratulated for having such nice fellows performing this service, setting such a good example, that others could follow if they would.

Conversation was had with a couple of old fellows who were irrigating. The land was so level, they seldom had to use their shovel. My little boy, 3 years old, could irrigate that land.

Sincerely yours,

HAROLD LINN.

¶Thank you, Mr. Linn.—Ed.

(*More Letters on Page 80*)

News Round-up

Irrigation in Sub-Humid Areas

Crop results on the W. C. Austin project in western Oklahoma are being watched closely as a guide to the future development of irrigatiton in subhumid areas. Some crops have been irrigated with water from the Altus reservoir in 1946 and 1947. The rainfall in those years was 24 and 26 inches, respectively. The benefits in increased income from irrigation are shown by the following table:

Average Gross Crop Income Per Acre

	1946	*1947*
Irrigated land	$130.72	$105.34
Nonirrigated land	22.09	43.86
Increase due to irrigation	108.63	61.48

The year 1946 demonstrated the advantages of irrigation with poor rainfall distribution. The 1947 season was more favorable for dry land farming. Nevertheless, irrigation increased the average crop value $61.48 per acre.

The results to date indicate that during most years the application of irrigation will create increased crop yields and income, and stabilize the farm economy of a project where rainfall may be slightly over 20 inches.

Bids Received for Hungry Horse—Biggest Postwar Job

April 1 was scheduled as the opening date for bids on Hungry Horse Dam (see February 1947 RECLAMATION ERA), fourth largest concrete dam in the world, and the Bureau of Reclamation's largest single construction job since the war. The dam will be located on the South Fork of the Flathead River, 9 miles southeast of Columbia Falls, Montana.

The dam is designed to provide hydroelectric power, flood control, irrigation water for lands in Western Montana, and stream regulation for the Columbia River which will increase firm capacities of existing Columbia River plants.

Specifications call for the construction of a concrete arch dam approximately 520 feet above foundation, 2,115 feet long, with an arch radius of 1,200 feet. Approximately 3 million cubic yards of concrete will be used in the dam and appurtenant structures.

Other features of the project include a power plant with a 300,000 kilowatt capacity, a 30-foot roadway across the top of the dam, and a glory-hole spillway with a tunnel 24.5 feet in diameter through which will pass a flow of 53,000 cubic feet of water per second.

Peak employment is estimated to be between 3,000 and 4,000 workmen with an average monthly pay roll of $600,000.

Power Program Pushed

The revised Reclamation construction schedules provide for an increase of almost 3,000,000 kilowatts or 4,000,000 horsepower generating capacity in the West by June 30, 1953.

All of this power would be hydroelectric with the possible exception of a small steam generating plant with a proposed installed capacity of 160,000 kilowatts in the Central Valley project. These proposed developments would not only rapidly advance western river-basin development by using water now being wasted, but would also relieve the pressure on critically short fuel stocks through the substitution of hydroelectric power. In addition to these power developments the Bureau also hopes to provide new and supplemental irrigation water for an additional 4,000,000 acres of land by late 1953 or early 1954.

Riverton Crops at Peak

A new crop-production record was established on the Bureau of Reclamation's Riverton project, in Fremont County, Wyo., during the 1947 season when crops valued at $2,360,848.99 were produced on 38,594 acres under cultivation. The 1947 return averaged $61.17 an acre, an increase of $3.94 over the 1946 average of $57.23 per acre.

The gross value of crops raised on the Riverton project during the last 3 years exceeds the government's investment in the operating portions of the project by more than one-half million dollars. Crops raised during 1946 and 1947 alone were valued at more than 80 percent of the approximate $5,500,000 investment in the completed portions of the project.

The three leading crops in 1947 acreages planted and gross returns were:

Crops	*Acres planted*	*Gross return*
Commercial beans	11,361	$1,123,359.60
Sugar beets[1]	1,224	189,162.00
Oats	3,963	169,126.20

[1] During 1947 Riverton farmers also received Federal payments totalling $44,143.29 for their 1946 sugar-beet production and soil-conservation practices.

The greatest per-acre return, $204.13, was realized from 501 acres of white potatoes valued at $102,270. The return from sugar beets, including the value of the beet tops, ranked second in per-acre return.

Cereal grains of all types produced on the Riverton project in 1947 were valued at $422,254.95, an average return of $47.84 for each of the 8,827 acres planted in these crops.

A return of $47,916.15 was realized from 1,715 acres of seed crops, an average return of $27.94 an acre. Hay and forage crops valued at $413,523 were produced on 52,831 acres, or $7.83 an acre. The hay and forage crop value includes sugar beet tops and grain straw.

Vegetable and truck crops, which include commercial beans and potatoes, were valued at $1,243,849.60, a return of $102.55 from the 12,129 acres of these crops under cultivation.

Livestock, poultry, and equipment owned by Riverton project farmers were valued at $1,687,941. Of the total amount, the value for horses was $24,995; cattle, $369,620; sheep, $185,507; hogs, $56,112, and poultry, $44,932. Motor vehicles and farm equipment were valued at $1,006,775.

Topography and Irrigation Farming

(Continued from page 69)

result, many inefficient operating units still remain on most projects to plague both the operators of the irrigation systems and the farmers themselves.

On the million-acre Columbia Basin project, the adjustment will be made, where practicable, before irrigation water reaches the land. It is complicated enough to transfer small land parcels among affected owners, even before irrigation starts; but it is far easier to make the adjustment at such a time than to wait until the area is thickly settled by resident farmers.

On other projects, the Bureau of Reclamation has been handicapped in its efforts to lay out farm units on private land based on topographical considerations, because it could not do more than recommend the necessary transfers of land to the owners involved. On the Columbia Basin project, however, the adjustment is greatly facilitated by the Bureau's authority to acquire and sell land. This authority is provided to the Bureau under the terms of the Columbia Basin Project Act.

The farm pattern on the Columbia Basin project also involves access to a road for each unit and facility of service for each unit by electric and telephone lines. To minimize road mileage, units will be shaped to avoid the need for numerous crossroads; they will adjoin roads on the narrow side wherever practicable.

The logic of laying out irrigated farms in adjustment to topography was recognized in Reclamation Law back in 1906—the Act of June 27, 1906 (34 Stat. 519)—authorized irregular subdivision if necessary to permit practicable and economical irrigation. When planning for development of land in the Columbia Basin project was inaugurated in 1939, specific consideration was given to the subject. Problem 8, one of 28 in the Columbia Basin Joint Investigations, called for designating certain areas in the project within which farms should be laid out in adjustment to topography.

The report on Problem 8 was prepared by H. A. Parker, now Supervising Engineer of the Irrigation Division of the project, in cooperation with Harry G. Ade, former Assistant Regional Conservator of the Soil Conservation Service. It recommended that great blocks of land, principally in the rolling, eastern uplands of the project area, be subdivided into farm units based on topographical considerations. The report also suggested certain principles to be followed in farm-unit lay-out.

These principles are now being applied on the drafting boards of the lay-out engineers and land-development specialists. The first irrigation block in the project, the 5,361-acre Pasco Pumping Unit, has 84 farm units laid out largely in adjustment to topographical features. The boundaries of these units are formed by ridges and hollows, and by roads, canals, and laterals. Each unit will be supplied with water through one headgate at its high point.

Landowners in this area have supported the Bureau of Reclamation's objectives. The Bureau in return has given maximum recognition to the landowners' rights and wishes. Both have taken the viewpoint that even though small ownership transfers are tedious and time-consuming matters at any time, it makes good sense to shape up the farm properly before the costly process of farm improvement is begun.

The Pasco Pumping Unit, which is scheduled to receive its first water in the spring of 1948, is the precedent for a large proportion of some 16,000 family-size farm units which eventually will be laid out in the project.

As explained earlier, farms are being laid out in cooperation with the private landowners, who hold about 60 percent of the project's irrigable acreage. Every attempt is being made to comply with the landowners' desires. And wherever it will not result in inefficient irrigation practices, such as in the huge basins and slopes of the western part of the project, rectangular farms will be laid out. •

MORE LETTERS

PALO VERDE IRRIGATION DISTRICT,
BLYTHE, CALIFORNIA,
February 28, 1948.

DEAR EDITOR: In the February issue of the ERA, I read, with appreciation, your announcement about the Bureau publication—"Control of Weeds on Irrigation Systems."

Ten years ago, when California's weed menace threatened to be a problem beyond our ability to control, I wrote an article that was widely published throughout the Southwest.

It was the opinion of some of my critics of 10 years ago that the United States Reclamation Bureau would not take kindly to certain remarks expressed in my article; and so I mailed a copy to Washington.

Mr. R. B. Williams—then Acting Commissioner—replied immediately, and his letter was very, very pleasing and encouraging to me.

Riverside County, California, largely due to wartime, efficient labor deficiencies, is again worried over its weed menace; and again we are trying to enthuse cooperation in a weed eradication campaign.

I regret the caustic criticisms of various publications that denounce the Department of the Interior for its failure to sell some of its marginal lands to veterans. During the past several years, I have deterred hundreds of veterans from expending their hard-earned savings for the acquisition of sand dunes, alkali areas, etc.

Sincerely yours,

ED F. WILLIAMS

¶We are glad to see that reader Williams (whose biography was reprinted in the July 1947 RECLAMATION ERA from DESERT magazine) continues to fight for reclamation essentials. Former Acting Commissioner R. B. Williams' letter of October 19, 1938, is well worth a quote or two:

I was especially interested in the statement: "It [weed control] is a job that necessitates the aid of the Federal Government and a job that must be started NOW! Millions are being expended in an attempt to reclaim new acreages. Why add new acreages to become propagating gardens for pests? The United States Reclamation Service must perform a new service—a service by which the saving of existing acreage must supersede the creation of new acreage."

We have felt for some time that the weed menace was a real problem and during the past few years in addition to working with other agencies in bringing to project settlers practical methods of controlling weeds, we have used CCC enrollees to carry on demonstration weed control projects. Along with the educational articles in the RECLAMATION ERA *and the encouragement of similar articles in project newspapers, we have prepared slide-lectures on noxious weeds, which are given by leaders of the project at farm meetings in order to educate farmers concerning the source, spread, root habits, and eradication of perrenial weeds.*

In the 10 years since the two Williams (so far as we know, not related) discussed the need for weed control, the Bureau has continued to help reclamation farmers in their fight against weeds. We need and appreciate the continued support of men like Ed. F. Williams.—Ed.

NOTES FOR CONTRACTORS

Contracts Awarded During February 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2005	Columbia Basin, Wash.	Feb. 5	1 unit substation for service building, Grand Coulee power plant.	I–T–E Circuit Breaker Co., Philadelphia, Pa.	$14,160
2010	Davis Dam, Ariz.-Nev.	Feb. 26	Station service and unit control and power equipment for Davis power plant.	Wolfe and Mann Mfg. Co., Baltimore, Md.	82,030
2014	do	Feb. 4	1 governor gallery crane for Davis power plant.	Star Iron and Steel Co., Tacoma, Wash.	50,570
2016	Missouri Basin-Canyon Ferry unit, Mont.	Feb. 3	Construction of warehouse building at Canyon Ferry government camp.	Carson Construction Co., Helena, Mont.	45,282
2017	Davis Dam and Central Valley, Ariz.-Nev.-Calif.	Feb. 6	One traveling crane for Davis power plant, item 1.	Euclid Crane and Hoist Co., Euclid, Ohio.	16,190
2017	do	Feb. 3	One traveling crane for Tracy pumping plant, item 2.	Moffett Mfg. Co., Albany, Calif.	18,990
2029	Missouri Basin-Canyon Ferry unit, Mont.	Feb. 20	Erecting 14 prefabricated residences at Canyon Ferry government camp.	Dillon Construction Co., Bozeman, Mont.	55,882
2032	Central Valley, Calif.	Feb. 16	Carrier-current line traps and coupling capacitors.	General Electric Co., Denver, Colo.	108,200
2033	Columbia Basin, Wash.	Feb. 11	Three air compressors for Grand Coulee power plant, schedule 1.	Worthington Pump and Machinery Corp., Harrison, New Jersey.	15,934
2036	Colorado-Big Thompson, Colorado.	Feb. 20	1 pump gallery crane for Granby pumping plant.	Star Iron and Steel Co., Tacoma, Wash.	20,400
2041	Columbia Basin, Wash.	Feb. 10	Three 108,000-kilovolt-amperes generators, for units R4, R5, and R6, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	5,328,000
2045	Klamath-Tule Lake division, Oregon-California.	Feb. 11	Construction of pumping plants, Coppeck Bay extension.	George R. Stacy, Tulelake, Calif.	128,375
2046	Boulder Canyon, Nev.	Feb. 24	Construction of supplemental water supply line for Boulder City.	N. P. Van Valkenburgh Co., South Gate, Calif.	511,056
2048	Columbia Basin, Wash.	Feb. 10	Nine 43,000-kilovolt-amperes transformers for units R4, R5, and R6, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	1,088,686
2052	Owyhee-Mitchell Butte division, Oregon-Idaho.	Feb. 16	Construction of earthwork and structures for Locket Gulch wasteway (drop channel).	George B. Henly Construction Co., Caldwell, Idaho.	155,647
2058	Colorado-Big Thompson and Missouri Basin, Colorado-South Dakota.	Feb. 18	Fixed wheel gates for Angostura dam, items 3 and 4.	Northwest Marine Iron Works, Portland, Oreg.	20,338
2065	Missouri Basin-Frenchman-Cambridge unit, Nebraska.	Feb. 26	Hollow jet valves and erection equipment for Enders dam.	United Engineering Co., San Francisco, Calif.	39,690

Construction and Supplies for Which Bids Will be Invited During April 1948

Project	Description of work or material
Central Valley, Calif.	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado.	Construction of about 50 miles of 69 kilovolts wood-pole transmission line from Brush to Yuma, Colo.
Columbia Basin, Wash.	Completion of Grand Coulee pumping plant, warehouse A and B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.2, machine shop and central heating plant, addition to right training wall, and water storage reservoir for Coulee Dam; assembly of caisson seat form and face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
Davis Dam, Ariz.-Nev.	Steel towers for 230 kilovolt transmission line at Davis Dam.
Deschutes, Oreg.	Completion of construction of Wickiup Dam and relocation of forest service road.
Do	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base.
Gila, Ariz.	Construction of check and turnout on the Gila Gravity Main Canal.
Klamath, Oreg.-Calif.	Improvements of about 7 miles of Lost River Channel through Poe Valley.
Mirage Flats, Nebr.	Erection of office building, three prefabricated residences, warehouse, utility buildings, well pump-house and elevated tank, and installation of utilities on State Highway No. 87, about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Kans.	Erection of 25 prefabricated residences, office building, warehouse, laboratory, and utility buildings; furnishing and installing utilities for Cedar Bluff government camp.
Do	Construction of Cedar Bluff Dam, an earthfill structure, near Hays, Kans.
Missouri Basin, N. Dak.	Construction of Dickinson Dam, an earthfill structure, Heart River Unit, near Dickinson, N. Dak.
Missouri Basin, Colo.	Erection of 12 two-bedroom and 4 three-bedroom prefabricated residences at Narrows Dam government camp.
Missouri Basin, S. Dak., Wyo., Mont.	Furnishing and erecting prefabricated, precut, or sectionalized residences for government camps at Shadehill and Bixby Dams, S. Dak., Keyhole Dam, Wyo., and Moorehead Dam, Mont.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Provo River, Utah	Construction of steel pipeline and structures for Big Cottonwood section.

SPRING CHECK-UP—These familiar springtime scenes show: (top photo) Bert Patrick (left) and Tom Mayes patrolling a section of the canal; at right, Tom fills a gopher hole while Bert supervises; and above, Bert greets Lee Wilson, a third ditchrider, at their headquarters shack. Despite the popularity of modern cars, these men prefer to ride the ditches on horseback. The photos were taken on the Settlers irrigation district of the Boise project in southwestern Idaho by Stanley Rasmussen of Region I.

v. 34 no. 5

MAY
1948

Featuring:

- West-Wide WATER Forecast
- A New Killer for Water Weeds
- PLOW, PLANT and PRAY by ROBERT S. KERR

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THE Reclamation ERA

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OUR BACK COVER

Aerial view of W. C. Austin project, Oklahoma, featuring the Altus Dam, key feature of this development, which will ultimately provide irrigation water for approximately 50,000 acres of previously dry-farmed land. This photo was taken by Preston W. George, Civil Engineer, Region V, on September 5, 1947, during the dedication ceremonies for the project.

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Ruth F. Sadler, *Editor*

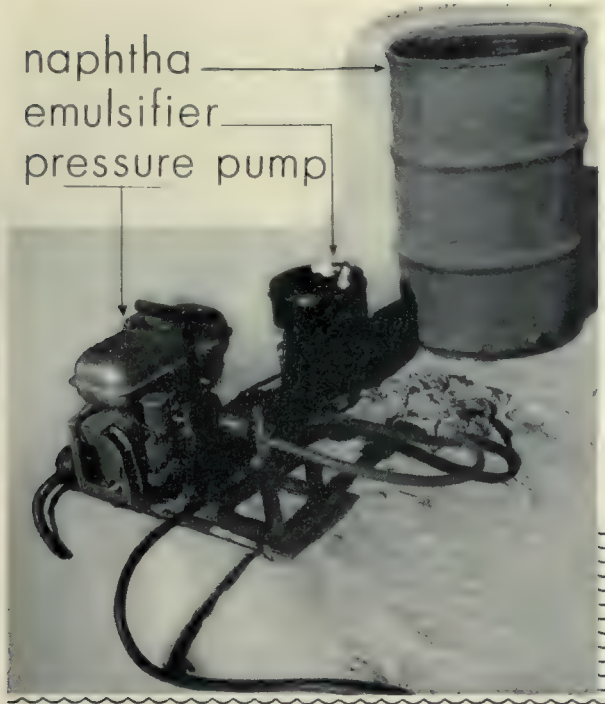
OUR FRONT COVER

SPRING CLEANING—New water weed killer described on page 81 does away with the necessity for this type of arduous labor. Here, on the Boise project we see workmen on a newly constructed boom pushing and prying loose the troublesome weeds so that they will continue along their path to the wasteway graveyard. Attached to the boom is an apron hanging two or more feet below the surface. This, plus the force of the current, directs the moss and weeds into the wasteway structure. This photo was taken by Phil Merritt, Region 1.

A NEW KILLER for Water Weeds

by W. T. MORAN and J. M. SHAW

Branch of Design and Construction, Denver, Colo.



Above, early "extinguisher system" with which naphtha was applied to canals at 50 pounds pressure per square inch.

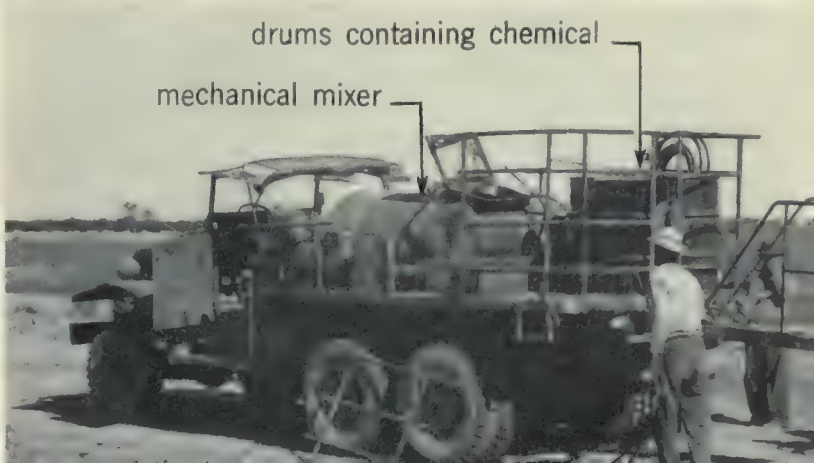
Western irrigation farmers spend millions of dollars every year for controlling submersed waterweeds (commonly called moss) in canals. Because most control methods used in the past were expensive and laborious, they often were not used until conditions became serious and irrigation canals were delivering but a fraction of the precious water they were designed to carry.

Relief from this costly waterweed infestation is now a definite probability. A simple treatment that can be accomplished at a very low cost promises to restore infested canals to their original capacity for carrying water. A chemical compound that goes to work on weed tissues and literally takes the life out of them has been developed through the weed research program being conducted cooperatively by the Bureau of Reclamation, Department of the Interior, and the Bureau of Plant Industry, Soils and Agricultural Engineering, Department of Agriculture.

You can fully appreciate the magnitude of the problem created by waterweeds when you consider the potential loss and damage they may cause. Besides cutting down the capacity of irrigation canals, waterweeds cause silt to be deposited which makes costly dredging necessary. Another toll taken by these weeds is loss of water through increased evaporation and seepage. When the canal water level must be raised above normal in an attempt to increase the flow of water (retarded by waterweeds), canal erosion and even canal breaks are common results which can be charged to waterweeds. Rank growths of waterweeds clog drains, cause them to function poorly, may keep potentially good land waterlogged, and increase alkaline deposits in the soil. In extreme cases, crop yields have been reduced when the former temporary, but often costly, methods were practiced too late to prevent pinching off part of the vital water, particularly in years when the supply was not too plentiful.

The Department of the Interior has applied for a patent for the new chemical mixture, which has had several field trials, with every indication that it is a powerful weapon not only in controlling certain aquatic weeds but also snails, crayfish, and mosquito larvae. Research so far has shown the mixture to be very effective on the stems and leaves of the plants tested, but some regrowth from the roots has been known to occur. It is too early in this stage of development and testing of the new aquatic herbicide to predict their eventual affect on the root systems of waterweeds. Much more information on this phase of the results should be obtained from field trials planned to be made this year.

This improved mechanized general purpose "extinguisher system" used by the Imperial Irrigation District features pump pressure capable of applying 450 pounds per square inch of the water-weed-choking naphtha to canals.



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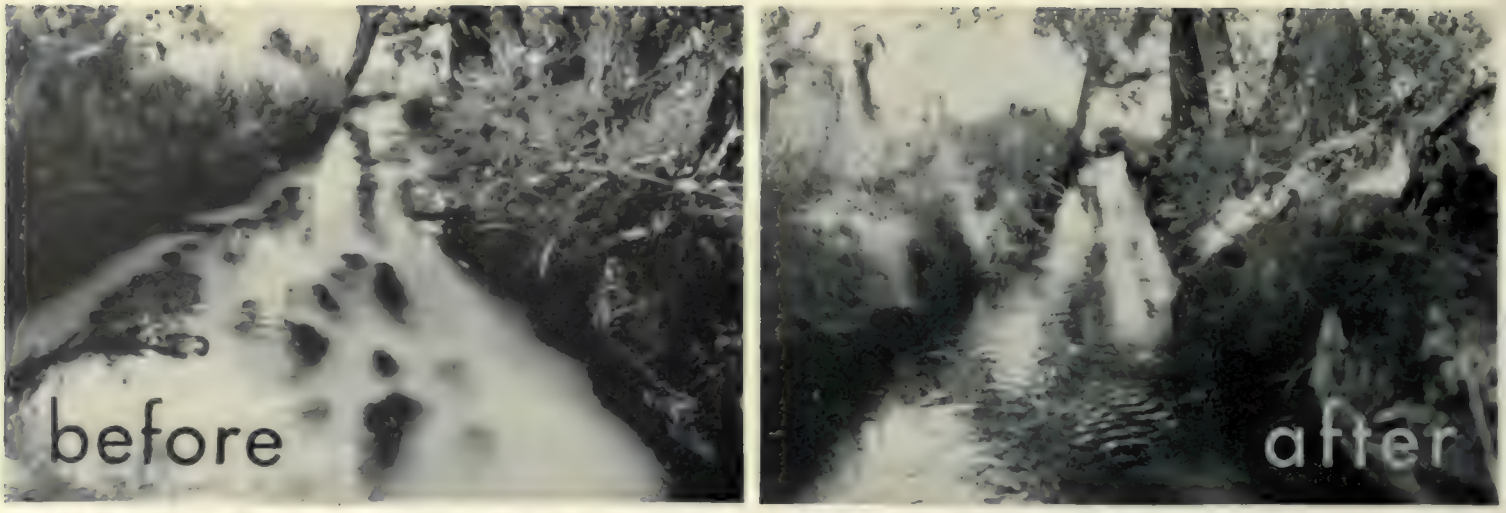

LEFT: New naphtha killer forms white blanket in Yokum Irrigation Ditch, Arvada, Colo. RIGHT: Same ditch 2 weeks after treatment. Note absence of water weeds at right.

But two warnings are necessary here and now: First, the new formulation, the physical properties of which are printed in a box accompanying this article, must be handled with caution; and second, tests thus far indicate the formula is toxic to fish. In other words, just as you can't have your cake and eat it, neither can you kill weeds with the new chemical and have all of your fish.

The research group in the Denver laboratory is continuing its work in developing more economical and permanent methods of weed control and it is hoped that eventually a chemical may be found that will be effective on plants but not injure fish. The Bureau has always been an advocate of wildlife conservation as attested by its many years of work with the Fish and Wildlife Service in helping develop refuges on irrigation reservoirs. However, the Bureau's first obligation is to the water users which it serves. For this reason it is not justifiable, in order to save a few fish, to practice water-weed control methods which may cost hundreds of dollars per mile when methods costing only a few dollars are available.

It isn't enough to develop a chemical to control weeds as a last resort when the ditches are completely choked. Irrigation district officials have been looking for a formula which can be produced at a cost which they can afford to pay for preventing such conditions before they get out of control. Bureau chemists are confident, and even enthusiastic, that they have this problem licked. The new formulation is so inexpensive that its use can be started at an early stage of the weeds' growth, and additional applications can be made as required during the season. This method would help maintain the full capacity of the ditches, hold down evaporation and seepage, and prevent much of the sediment collecting in the channels.

The first field test of the new mixture was conducted by the authors, with the aid of Region VII officials, in the main canal of the Riverside Irrigation Co. near Fort Morgan, Colo. The canal has a design capacity of 300 cubic feet per second but was so badly infested with a species of weed, know as the horned pondweed (*Zannichellia palustris*), that the maximum flow had been reduced by 50 percent. After carefully treating the canal with the new formula, the full carrying capacity was restored within 72 hours. Here's how it was done: To coal-tar naphtha (with a boiling point range of 135° to 208° C.) was added emulsifying agents consisting of equal parts of mahogany soap and sulfonated castor oil. This mixture was introduced into the canal beneath the surface of the water at a pressure of 50 pounds per square inch through a spray nozzle with a 0.02-inch opening. A small motor-driven pump was used to pump the chemical from drums into the canal.

Perhaps one of the most important features of the new mixture is its apparent ability to kill weeds regardless of the stage of growth. While practically all field tests were conducted when weeds were at their hardiest, an exception was made on the Yocum Ditch near Arvada, Colo. Because the season was so far advanced when the chemical was applied, the weeds were entering their dormant stage. A concentration of 185 parts per million of the same type emulsified naphtha used in the first field trial was maintained for 60 minutes. This test was so successful that within 72 hours after treatment the ditch was free of weeds for a distance of 1 mile below the point of application. Under ordinary conditions chemicals would not usually be applied at that stage of growth because the plants naturally begin to break loose by themselves.

During November of 1947 extensive tests were made on irrigation facilities of the Imperial Irrigation District of California and on the Yuma and Gila projects of the Bureau of Reclamation near Yuma, Ariz. The only change made in the mixture was to reduce the emulsifying agent, mahogany soap, from 10 to 5 percent by volume. All of the tests were eminently successful (*with the possible exception of the treatment of the canal on the Gila project where a combination of factors, principally inadequate mixing of ingredients, resulted in a rather weak kill of the weeds present*). They confirmed the laboratory investigations as well as the earlier field trials. Good mixing, pump pressures of 450 pounds per square inch, and small nozzle openings all helped to increase the efficiency of the treatments by causing better dispersion in the water, thus sending the emulsion further downstream before it broke and rose to the surface.

A similar test to those described was conducted in a

canal of the Black Canyon irrigation district near Boise, Idaho, by J. M. Hodgson of the Bureau of Plant Industry, Soils, and Agricultural Engineering in cooperation with Bureau project personnel. Sago pondweed (*Potamogeton pectinatus*) was the predominating species but there were also scattered patches of horned pondweed and both species were in an advanced stage of maturity in this test made October 2, 1947. Seventeen gallons of coal-tar naphtha with 5 percent mahogany soap were sprayed into the canal carrying a measured flow of 3.1 cubic feet per second, enough for a concentration of 200 parts per million for a period of 1 hour. Ninety percent of the leaves and stems of sago pondweed had turned brown within 24 hours. Horned pondweed reacted more slowly but the final injury was about the same. Two weeks after treatment the water was turned out of the canal for the winter. At that time about one-third of the aquatic plants remained and were starting to produce new leaves. It was noted that injury to the pondweed was more severe from a point a few hundred feet below the application to three-fourths mile downstream than it was at the point of introduction. This observation emphasizes the need for thorough mixing of the chemical with the water in order to get the best effects. The advanced maturity of the weeds at the time of treatment probably prevented a more complete kill of the top growth.

Field trials so far have indicated that 185 p. p. m. (parts of chemical per million parts of water in the canal) gives satisfactory control when this concentration is maintained for 1 hour in contact with the waterweeds. To obtain 185 p. p. m. for an hour, 5 gallons of the chemical formulation must be applied to each cubic foot per second of flow over a period of 1 hour.

For example, if it has been determined that the canal or drain is flowing at the rate of 12 cubic feet per second at the time of treatment, it will require 60 gallons applied over a period of 1 hour or 1 gallon of the mixture per minute. Each gallon of chemical applied over a period of 1 hour to each cubic foot per second will give a concentration of 37 p. p. m. Therefore, when special cases seem to warrant higher concentrations, it is necessary only to divide the desired concentration by 37 to determine how many gallons of the chemical should be applied per cubic foot per second of flow per hour. Inasmuch as the amount of chemical necessary to control the weeds is directly proportional to the volume of water in the canal, it is always recommended that the flow be reduced at the time of treatment. However, it will be necessary to have the weeds completely covered.

Although it was found in the laboratory that many chlorinated hydrocarbons and other compounds will kill the stems and leaves of waterweeds, nothing has yet been found that will compete with the aromatic solvent naphthas in availability, efficiency, and cost. Prices of acceptable materials now range from 18 to 42 cents a gallon.

The Denver research group developed a screening technique for testing a large number of various chemicals and eliminating those which were not effective. They collected several species of waterweeds and let them grow under controlled laboratory conditions in large glass tanks containing circulating water. Then the technicians treated sections of stems, leaves, and bud ends of the various species of plants in beakers containing different concentrations of a specific chemical for a given time. They carefully watched and took notes on the effects of the material on the plant tissues. The reward for their patience, meticulous care and scientific methods was the discovery of the new mixture.

The research work conducted in cooperation with the Bureau of Plant Industry is only one phase in the over-all program of weed control launched by the Bureau of Reclamation under the direction of its agronomist, Robert B. Balcom. Working closely with Bureau weed control specialists, the Bureau of Plant Industry, Soils and Agricultural Engineering, has established field stations at Phoenix, Ariz.; Prosser, Wash., and Meridian, Idaho, under the direction of L. W. Kephart, senior agronomist in that Bureau. These stations make large-scale weed control tests under natural field conditions. Also, the Bureau of Plant Industry assigned one of their plant physiologists, Dr. R. S. Rosenfels, to full-time cooperation in the Bureau of Reclamation laboratories in Denver. In addition to waterweed control, the research program includes various investigations such as soil sterilization and toxicity studies of various chemical agents to crop plants.

An interesting sidelight of the weed control investigations has been snail control. Although snail control is of minor importance in the United States, it is a problem of no little significance to other countries. Egypt is vitally concerned because many species of snail serve as hosts for parasites such as blood flukes, liver flukes, etc. The disease caused by these parasites often reaches epidemic proportions along the Nile River. Snails feed on waterweeds; therefore, control of their food supply should reduce the snail population. More important, however, the Bureau's chemists discovered in field

(*Continued on page 93*)

R. F. Blanks, Chief, Denver Laboratories, explains experiment on water weeds to Under Secretary of the Interior Oscar L. Chapman.

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Photo by Harris & Ewing

Plow ~ Plant ~ and Pray

"~ *Then will I hear from Heaven* ~
and will heal their land." *I Chronicles 7:14*

by ROBERT S. KERR, former Governor of Oklahoma

WHEN THE '89ERS SWARMED OVER THE PLAINS AND PRAIRIES of Oklahoma to take up homesteads, they found the red men had been well settled on the fertile bottom lands along the streams. This was, probably, because here was fuel, water and food—and, the richest soil under the sun.

Sixty years! And Oklahoma has made history and a name for herself. Today, she is famous for her fighting sons with the pioneer spirit of their forefathers; for her oil and her agricultural achievements. But, today, she is beginning to realize that the "drops of water and grains of sand" must be nurtured and cared for and not so ruthlessly treated as in those yesteryears.

Great progress has been made toward conserving her land and water resources but the job is not done, nor will it ever be done. We must keep on, if we are to get the most out of their use and leave similar opportunities for our posterity.

Those bottom lands of the red man, along our creeks and rivers, are today's challenge to strong-hearted men. They are the source of succulent harvests if we regiment them to our purpose.

The Oklahoma farmer's rule is plow, plant, and pray—pray that the rains will come—not too much, not too little, not too late, but just right to provide bountiful harvests.

We have in Oklahoma, 2,810,000 acres of fertile, alluvial lands in the flood plains of our streams. We have an additional 1,300,000 acres of second bottom lands. These bottom lands are all classified as superior soils. It is estimated that at least 1,000,000 acres of the land in the flood plains are not farmed because of the frequency of floods, and not because the soils are inadequate for agriculture. If the lands in the flood plains that are now cultivated were protected from floods, their productivity would be materially increased, and they could be farmed more intensively. The flood damage to agriculture in the State of Oklahoma is estimated to aggregate $6,000,000 a year. The orderly selective construction of impounding and protective works will bolster materially the resources of the lands in Oklahoma.

The average rainfall in Oklahoma varies from 17 inches annually in the extreme northwestern corner of Cimarron County to 55 inches in the southeastern corner of Oklahoma. Many studies have been made of the climatic conditions of the State, all producing about the same results as to rainfall and its distribution. Rainfall in the western half of the State, or the area west of the ninety-eighth meridian, although amounting to about 25 inches a year (which under normal conditions is ample to produce crops) is so poorly distributed as to render much of the annual total of little value to growing crops. In other words, torrential rains resulting in high intensity run-off produce flash floods during the spring. Therefore, they are not beneficial and often are detrimental to crop production.

A study of the frequent occurrence of droughts in the State of Oklahoma has revealed that the southwestern section of the State has suffered most severely from droughts and that the entire area of the State west of the ninety-eighth meridian probably could be classified as a chronic drought area. Droughts have occurred 13 times in 30 years serious enough to cut crop yields by 50 percent or more.

From this summary it is recognized that if the rain which falls could be stored when abundant and held until needed, there would be sufficient water to produce a good crop yield. A glance at the map of Oklahoma reveals a well-drained area. Conversely, we may add that this same identical drainage system, by and through skilled manipulation, can become an equally efficient watering system with which to dampen the parched acres along their course.

In light of this review of rainfall, run-off, flood, and drought patterns for Oklahoma, does not the answer to the old theory of "plow, plant, and pray" seem apparent? Obviously, insured crop production—stabilized farm income—by

A PRAYER IS HEARD as farmers see the first irrigation water come to "heal their land" on the Altus project in Okla. *R. M. Reynolds Photo.*

irrigation, is the answer. The soil is here, except the millions of tons which have been carried to and toward the Gulf since '89. The water is here in sufficient quantity to produce crops, supply municipal and domestic needs and to generate a little power if we but impound and harness the torrents. Other climatic conditions, temperature, growing season and the like are suitable for producing the base materials of agriculture and industry. Oklahoma has adopted an industrial slogan "you can serve best from the center." This applies likewise to the agricultural produce in relation to marketing. Notwithstanding great production of agricultural crops, we still import into the area a large part of the food that we eat in the form of fresh and canned fruits and vegetables.

Consider also some of the potential agricultural-industrial opportunities of Oklahoma, such as alfalfa mills, milk product plants, cornstarch factories, broom factories, peanut oil mills, cotton textile factories, new processing plants springing from chemurgic research, canneries, meat packing plants, cereal food factories, flour mills, commercial poultry and cattle feed manufacturing plants, commercial fertilizer plants, pecan and peanut candy factories, mattress factories and many others. All are based on a stable agriculture.

We spoke of "plow, plant, and pray." The farmer of Oklahoma has plowed, has planted, and has prayed that the rains would not come in floods, and that the droughts would not last long. Irrigation and flood control can answer that prayer.

In southwestern Oklahoma in the vicinity of Altus, the W. C. Austin reclamation project, the first Federal reclamation project to be constructed in the State, is now partially in production. Many are watching with a critical eye the results of this project in the great plains area. Its ultimate success will be a major factor in determining the destiny of other projects in like climatic areas throughout the Nation. As always, we in Oklahoma are optimistic about the outcome of this project. We know that it will be a success. We point at results thus far obtained to bolster our opinion. In 1946 while dry land farms in the area were producing on the average of $22.09 per acre, the irrigated lands of the W. C. Austin project produced $130.72 per acre.

Looking to the Bureau of Reclamation to guide us in our plans for other reclamation projects, we predict a new era for irrigated agriculture in the State of Oklahoma. END

_____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

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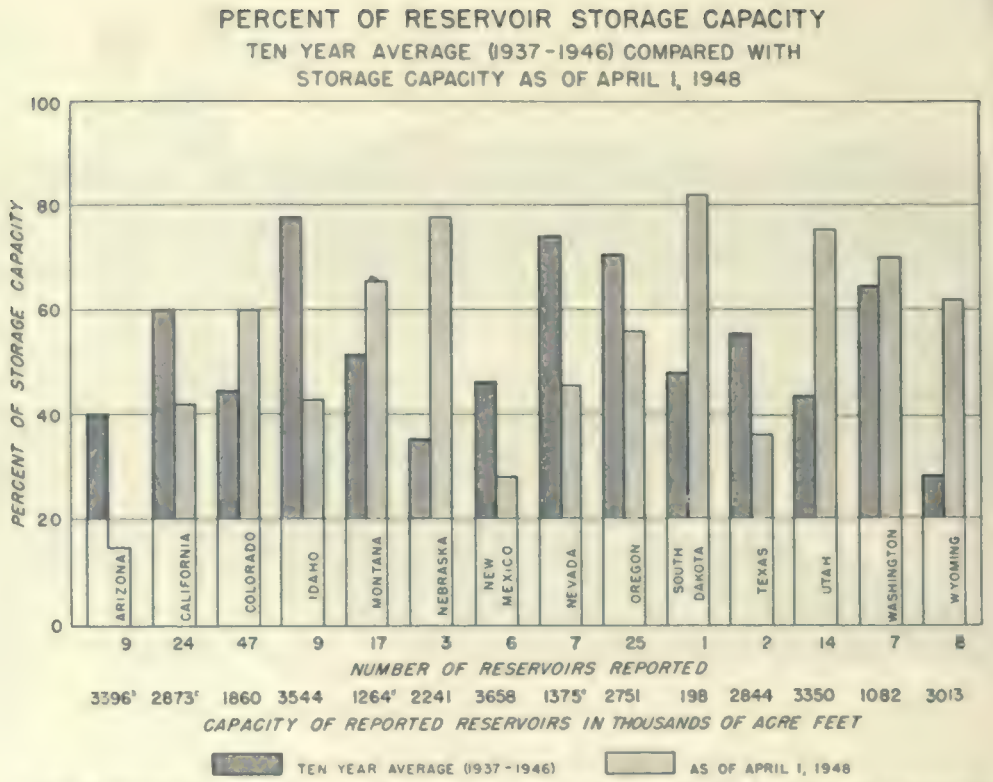


Not all reservoirs in all States are reported, but enough are reported to give a reliable index of each State's storage supply.

(b) Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included.

(c) Does not include Narrows (Yuba River), Friant or Shasta reservoirs. April 1 storage in these three reservoirs combined is 3,334,000 acre-feet, which is 78 per cent of their capacity.

(d) Does not include Fort Peck reservoir (capacity 19,000,000 acre-feet); April 1 storage 13,440,000 acre-feet.

(e) Does not include Lake Mead (capacity 31,140,000 acre-feet); April 1 storage approximates 18,620,000 acre-feet.

West-Wide Forecasts of 1948 Water Supplies Based on Work of the Western Snow Surveys

By Paul A. Ewing, Senior Irrigation Economist, and R. A. Work, Senior Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture.

What Do You Mean, *SNOW?*

Well, it may be snow to most folks, but to Western farmers it's water—water, without which there won't be crops next summer. To plan things right, we have to know how much snow lies on the mountain slopes—how much and what kind of snow. That's why the Bureau of Reclamation is continuing its cooperation with the Soil Conservation Service. S. C. S., through its Division of Irrigation and Water Conservation, is the Federal coordinating agency for snow surveys; the snow surveys, made throughout the Western mountains each spring, are the basis for forecasts of run-off to appear in later months.

You can't tell what snow means in terms of water just by looking at it. Its density varies widely from time to time and from place to place.

It is this wide variation that makes almost valueless snow measurements based only on depth. It's the water content that holds the secret of summer stream flow. Early attempts to forecast water supplies from depth measurements failed to take proper account of densities, but modern snow surveyors have turned the trick by taking many hundreds of samples periodically throughout the West. The sampler most widely used is an extensible light metal tube with a sharp cutting point, which when thrust into the snow, collects a core or column. The tube is graduated in inches and has longitudinal slits through which the snow core can be observed, and its length noted. Then the snow-filled tube is weighed on a scale so calibrated as to show the inches of water in the measured snow. Analysis of the many records obtained in this manner provides the basis for the water-supply forecasts.

The following paragraphs summarize the water-supply prospects, State by State, as indicated by the April snow surveys. A pattern similar to that of 1947 is indicated. Severe shortages again appear in prospect for the Southwest, including Arizona, Nevada, and much of California, but with marked improvement, progressing from south to north. An alarming outlook for California, persisting through the winter, was somewhat eased in late March and the early part of April, but the summer supplies still threaten to be greatly below normal. A marked, though belated improvement has also taken place in New Mexico, where reservoir storage, though still abnormally low, is expected to improve greatly with the increase of spring run-off. Conditions in the Rio Grande, Upper Colorado and Columbia river basins are generally satisfactory as are also those on the slopes east of the Rocky Mountains.

The two charts accompanying this article further summarize the results of the April snow surveys.

Arizona.—The long-continued water shortage throughout the main irrigated areas still persists. Although snow-stored water on the higher elevations is, in general, equal to any previously recorded high on April 1 it is not enough to overcome the critically low storage in practically all reservoirs. Since available storage is the most important factor in Arizona's irrigation supply, the fact that the total

amount of water held in the nine important reservoirs is only 10 percent of their total capacity has particularly gloomy significance. Apparently another season of heavy pumping from ground storage is in prospect.

CALIFORNIA.—Although the State is still faced with a short water year, the outlook improved a lot during March. Snow surveys early in the month showed such a poor pack that the outlook was for a record dry year similar to 1924. However, during March more snow fell than during the three preceding months. Before the end of the month the outlook had improved until a year similar to 1939 could be expected, and by early April, continued improvement had raised the outlook to equal to or better than last year. Many areas received as much snow during the first eight days of April as they normally get during the entire month. Forecasts based on conditions surveyed at the end of March are therefore subject to some additional qualification on the favorable side.

The assured run-off from the combined areas of the Sacramento and San Joaquin Valley watersheds, on the improved basis, is expected to be 51 percent of normal. Last year the corresponding over-all run-off figure was 49 percent of normal.

Run-off will be relatively better in the Sacramento Valley than in the San Joaquin. For the tributaries of the Sacramento River the average is 56 percent of normal, while for the San Joaquin River tributaries the average is 49 percent. Last year's comparable figures were 49 percent for both the Sacramento and San Joaquin Rivers.

Snow surveys from the Kings, Kaweah, and Kern watersheds, tributaries of Tulare Lake, indicate 5 percent less run-off than last year.

With the exception of Shasta and one or two other reservoirs, water stored is less than last year.

COLORADO.—The outlook is favorable. Summer flow of Colorado River and its tributaries is expected to be from 10 to 30 percent above normal. Snow cover is well above normal. On most tributaries the snow-water content is slightly above last year but on the San Juan, Animas, and Dolores Rivers it is substantially greater. Seasonal precipitation over the western slope has been much above average.

On the South Platte drainage, snow cover is slightly less than last year but substantially above the 13-year average. Above-normal flow is expected for all streams in this drainage. Reservoir storage is more than last year; many reservoirs are practically full already.

The outlook for the Rio Grande in Colorado is the best in years. Unusually heavy snows during February and March materially improve the outlook in this area. Reservoir storage is in excess of last year and there is a large amount of moisture stored in the soil. Above-normal streamflow is expected but flows will not reach flood proportions unless later weather conditions are abnormal.

IDAHO.—State-wide prospects are mostly fair, but are slightly better than that for Clearwater River Drainage. An over-all improvement occurred during March, when an unusually heavy fall of snow in the southern mountains overcame the previous deficiency. On all southern drainages having storage facilities the supplies will suffice for irrigation with careful use. In northern areas where the extra heavy pack had previously indicated a possible flood hazard, the danger has been eased by a March snowfall below normal.

MONTANA.—Snow accumulation on the headwaters of Missouri Basin streams continues above average except on the Madison and Milk Rivers. Although summer flow of these two streams is expected to be light, in general flows will be from 10 to 20 percent above normal. Reservoir storage is about the same as last year but substantially above the 10-year average. Precipitation on the plains has been below normal but soil moisture conditions in the irrigated areas range from fair to good.

NEVADA.—Water for irrigation will be in short supply throughout the State. Run-off from the Sierra will range from 25 to 50 percent of normal, and from normal to 60 percent of normal on headwaters of the Humboldt and its main stem. Snow-stored water on the Sierra is generally less than 50 percent of normal, but a 50 percent increase in snowfall during March brought the pack on the Humboldt headwater basin nearly up to normal. Reservoir storage is poor, being only about 45 percent of last year, and 55 percent of usable capacity.

NEW MEXICO.—The heavy snows that blanketed southern Colorado late in the winter extended into New Mexico as far south as Santa Fe. Conditions in this area are the best since 1942. Stream flows substantially above normal are expected in the Rio Grande tributaries except Chama River. Snow cover on this watershed is not as good as elsewhere, and storage in El Vado Reservoir is below normal. Elephant Butte storage is also low, but the early run-off will add materially to it. Precipitation has been above normal throughout the area. Soil-moisture conditions are good except in the Carlsbad area and the lower Rio Grande.

OREGON.—The outlook has improved greatly since midwinter and 1948 will be comparable to the good water year of 1946 in many areas. All but about 3 percent of all irrigated lands have in sight good to fair water supplies with the best supplies provided by storage. Greatly deficient supplies are not expected to be faced by any section although there may be some late-season shortages in some areas. Water stored in all reservoirs is about 20 percent less than last year, 23 percent less than in 1946, and 16 percent less than in 1945. Only 56 percent of the more important reservoirs are half full or better.

Mountain snow cover is above average on nearly three-fourths of all measured snow courses and is greater than last year at all stations. Watershed soils are much wetter than average, which greatly favors run-off from the snow pack. Cropland soils are generally well wetted, with moisture penetration in the dry wheat lands equaling that of the wet year 1943.

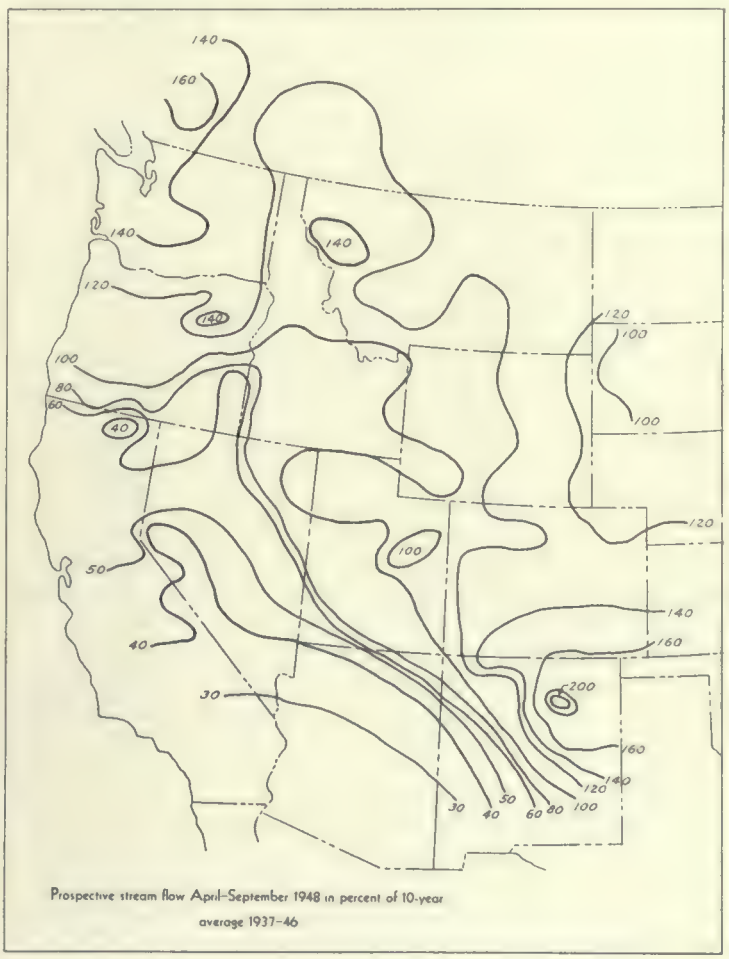
SOUTH DAKOTA.—Snow cover on the Black Hills is below average but 10 percent above last year. Recent precipitation has been deficient and soil moisture conditions are only fair. Storage in Belle Fourche Reservoir is greater than last year by 10,000 acre-feet.

UTAH.—Most watersheds will produce run-off sufficient to meet irrigation needs. Practically all streams will discharge at least 80 percent of the average run-off. Flood discharges of most streams threaten to be enough higher than a year ago to damage some irrigation systems and farm lands during the spring months. Late-season supplies should hold up fairly well. Storage generally is at high levels, with the principal reservoirs at 75 percent of capacity.

WASHINGTON.—Enough water will be available for all purposes, including hydroelectric power generation at Grand Coulee and Bonneville. The possible flood hazard indicated in February has, however, been eased by lower than usual March snowfall. The April–September flow of Columbia River at The Dalles is forecasted at 94,000,000 acre-feet, which compares with a 10-year maximum of 112,591,000 acre-feet (in 1943) and a minimum of 57,320,000 acre-feet (in 1944).

WYOMING.—Flows of all streams east of the Rocky Mountains will be slightly above normal. On the west slope of the Rockies conditions are not so favorable and it is anticipated that the flow of the Green River will be 20 percent below normal. Snow cover is less than last year but somewhat greater than normal, except on the Green River. Because of the large carry-over storage in the North Platte reservoirs an ample supply of stored water is assured.

Reports detailing the results upon which the foregoing summaries are based may be obtained by addressing the Division of Irrigation and Water Conservation, Soil Conservation Service, College Hill, Box D. Logan, Utah. Requests should identify the State or drainage basin about which information is wanted. END



Prospective stream flow April–September 1948 in percent of 10-year average 1937–46

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity[1]	Mar. 31, 1947	Mar. 31, 1948
Region 1	Baker	Thief Valley	17, 400	17, 400	17, 400
	Bitterroot	Lake Como	34, 700	20, 400	17, 400
	Boise	Anderson Ranch	464, 200	97, 800	76, 200
		Arrowrock	286, 600	247, 800	171, 000
		Deadwood	161, 900	116, 900	85, 100
		Lake Lowell	169, 000	158, 200	162, 400
	Burnt River	Unity	24, 600	24, 000	12, 100
	Columbia Basin	F. D. Roosevelt	5, 220, 000	5, 108, 000	4, 660, 000
	Deschutes	Crane Prairie	50, 000	41, 200	29, 900
		Wickiup	187, 000	97, 900	148, 200
	Minidoka	American Falls	1, 700, 000	1, 618, 400	1, 670, 900
		Jackson Lake	847, 000	577, 900	629, 600
		Lake Walcott	95, 200	69, 000	97, 000
		Grassy Lake	15, 200	12, 800	14, 000
		Island Park	127, 300	132, 400	136, 600
	Okanogan	Conconnully	13, 000	6, 100	4, 700
		Salmon Lake	10, 500	9, 400	4, 500
	Owyhee	Owyhee	715, 000	593, 600	397, 900
	Umatilla	Cold Springs	50, 000	50, 000	50, 000
		McKay	73, 800	66, 300	71, 000
	Vale	Agency Valley	60, 000	51, 900	45, 500
		Warm Springs	170, 000	136, 500	40, 800
	Yakima	Bumping Lake	33, 800	34, 400	13, 100
		Clear Creek	5, 300	5, 300	5, 300
		Cle Elum	435, 700	413, 000	296, 800
		Kachess	239, 000	220, 800	197, 300
		Keechelus	153, 000	154, 600	105, 300
		Tieton	197, 000	171, 300	140, 200
Region 2	Central Valley	Millerton Lake	503, 100	337, 600	112, 700
		Shasta	4, 389, 100	2, 758, 100	3, 030, 200
	Klamath	Clear Lake	437, 500	226, 700	152, 400
		Gerber	94, 300	42, 500	29, 000
		Upper Klamath Lake	524, 800	345, 100	330, 200
	Orland	East Park	47, 900	31, 700	18, 900
		Stony Gorge	50, 000	39, 800	25, 100
Region 3	Boulder Canyon	Lake Mead	27, 935, 000	16, 383, 000	18, 620, 000
	Parker	Havasu	688, 000	649, 000	607, 500
	Salt River	Bartlett	179, 500	10, 300	19, 600
		Horse Mesa	245, 100	234, 200	157, 600
		Horseshoe	67, 000	13, 700	10, 800
		Mormon Flat	57, 850	40, 600	23, 000
		Roosevelt	1, 398, 400	80, 600	54, 700
		Stewart Mountain	69, 800	52, 200	36, 500
Region 4	Fruit Growers	Fruit Growers	4, 500	2, 100	4, 600
	Humbolt	Rye Patch	179, 000	185, 900	120, 300
	Hyrum	Hyrum	15, 300	11, 900	10, 700
	Moon Lake	Moon Lake	35, 800	9, 000	13, 000
	Newlands	Lahontan	273, 600	241, 600	184, 900
		Lake Tahoe	732, 600	518, 400	261, 600
	Newton	Newton	5, 300	4, 900	4, 900
	Ogden River	Pine View	44, 200	14, 900	1, 100
	Pine River	Vallecito	126, 300	60, 100	57, 100
	Provo River	Deer Creek	146, 800	73, 400	127, 800
	Scofield	Scofield	65, 800	7, 600	15, 400
	Strawberry Valley	Strawberry	270, 000	115, 200	115, 200
	Truckee River Storage	Boca	40, 900	13, 800	4, 300
	Uncompahgre	Taylor Park	106, 200	70, 100	87, 400
	Weber River	Echo	73, 900	55, 300	38, 600
Region 5	W. C. Austin	Altus	140, 000	45, 500	72, 200
	Carlsbad	Alamogordo	128, 300	35, 600	37, 000
		Avalon	6, 000	3, 200	5, 300
	Colorado River	Marshall Ford	810, 500	497, 400	187, 600
	Rio Grande	Caballo	345, 900	266, 700	173, 300
		Elephant Butte	1, 817, 000	513, 900	395, 900
	Tucumcari	Conchas	300, 000	264, 900	271, 000
Region 6	Belle Fourche	Belle Fourche	177, 500	154, 800	161, 100
	Milk River	Fresno	127, 260	136, 700	77, 400
		Nelson	66, 800	27, 000	32, 200
		Sherburne Lakes	66, 100	23, 400	38, 500
	Riverton	Bull Lake	152, 000	69, 500	79, 400
		Pilot Butte	31, 500	15, 400	18, 100
	Shoshone	Buffalo Bill	456, 600	291, 900	307, 400
	Sun River	Gibson	105, 000	58, 600	64, 400
		Pishkun	32, 050	17, 200	20, 800
		Willow Creek	32, 400	15, 300	17, 200
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	64, 700	47, 300
	Kendrick	Alcova	190, 500	83, 700	109, 900
		Seminoe	970, 000	289, 200	535, 800
	North Platte	Guernsey	41, 050	31, 700	37, 800
		Lake Alice	11, 000	5, 800	0
		Lake Minatare	57, 000	20, 900	18, 000
		Pathfinder	1, 040, 500	472, 900	667, 800

[1] Available for Irrigation

HOMESTEADING TIME in YUMA

by

WILLIAM J. WILLIAMS

Special Assistant to Regional Director, Region III, Boulder City, Nev.

The fertile Yuma Valley in southwestern Arizona and southeastern California is again feeling the homesteader's plow.

Beginning this spring, 26 World War II veterans will be farming alongside oldtimers who homesteaded on the project in the early days. The new homesteads comprise 1,297 acres and range in size from 28 to 82 acres.

The drawing, which was held on March 10, 1948, at Yuma, Ariz., was the first to be held in Region III since the end of the war, and represents the tenth postwar land opening held by the Bureau of Reclamation. Since the Yuma opening, the second Tule Lake drawing has been held, making a total of eleven postwar public land openings to be held by the Bureau, covering a total of 34,097 acres which provided farms for 401 veterans.

About 300 spectators were present when the glass jar containing 541 capsuled names was unsealed in the American Legion hall. The homesteaders' names were drawn in rapid succession by representatives of veterans' organizations in the Yuma area and posted on a huge blackboard at the front of the hall. Fourteen of the 26 homesteaders were from Arizona, 8 from California, and one each from Washington, Oregon, Idaho, and Pennsylvania. Only five of these, all of the Yuma area, were present when the names were drawn. The first capsule contained the name of John C. Snyder, of Dalmatia, Pa.

The first six names which were drawn were those of homesteaders outside the local area. But No. 7 went to Yuma Veteran Everette Eugene Harman, a marine veteran of Guadalcanal and other South Pacific campaigns.

The No. 9 drawing brought forth the name of Fred Eugene Simons, Jr., of nearby Somerton. At that moment young Simons was working in the basement of a store only a few doors from the Legion Hall. A thoughtful friend hastened to break the good news to him and in a few minutes he strode into the hall to claim his farm.

Carlos F. Colvin, No. 13, heard the good news over the radio as he was eating lunch at his home in Eden, Ariz. The next day he drove to Yuma to look over his farm which proved to be part of the Bard town site. He has been doing quite well in the Safford Valley of Arizona growing cotton on 60 acres of leased land but water is short there and the prospect of fertile land in the Yuma Valley with a full water supply is mighty inviting.

No. 15 was claimed by sandy-haired Hayden Van Mitchell, of Arkansas, who had been farming leased land in the valley for the past 2 years. His new farm is only 5 miles from where he lived at the time of the drawing.

Everette Eugene Harman likes the looks of alfalfa and date trees growing on his homestead. ***Photo by Samuel B. Watkins, Region III.***

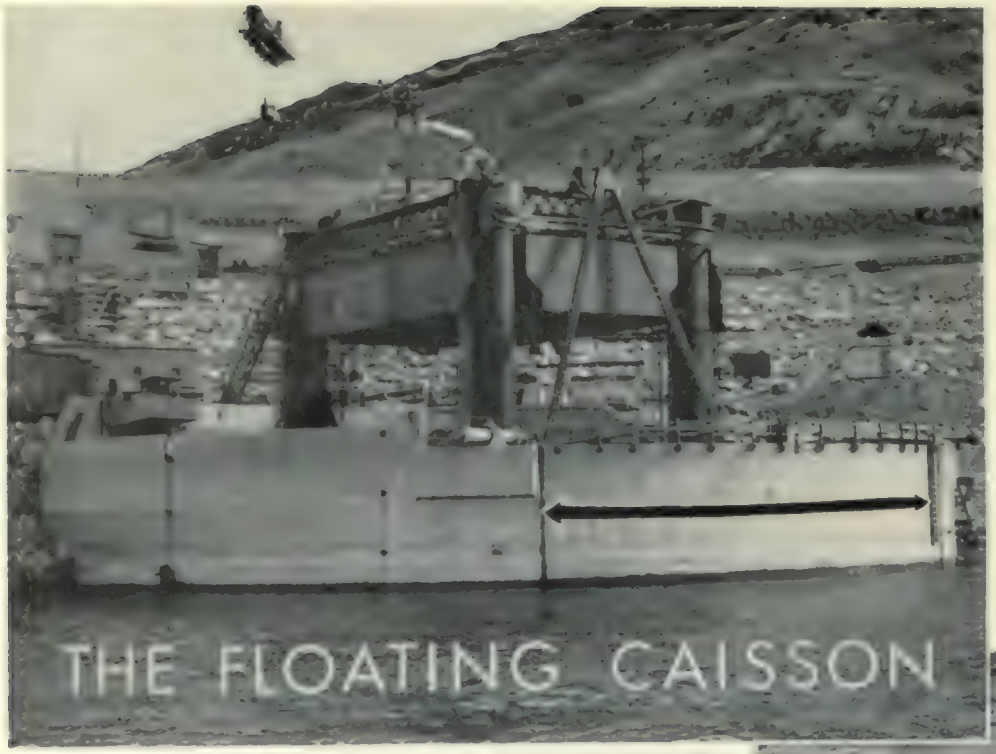
No. 18 was considered an unexpected and welcome wedding gift by Elgy A. Kryger and his bride of a few weeks.

When the name of Martin Reuben Ross, No. 20, of Yuma, was called, Ross, a lanky Texas veteran, leaped to his feet at the rear of the hall and whooped: "THAT'S ME!" With his wife and baby, he made his way dazedly to the front. It was a great day for young Ross, as he had come to Yuma 1 year ago expressly to work on an irrigated farm to add to the experience required for homesteading.

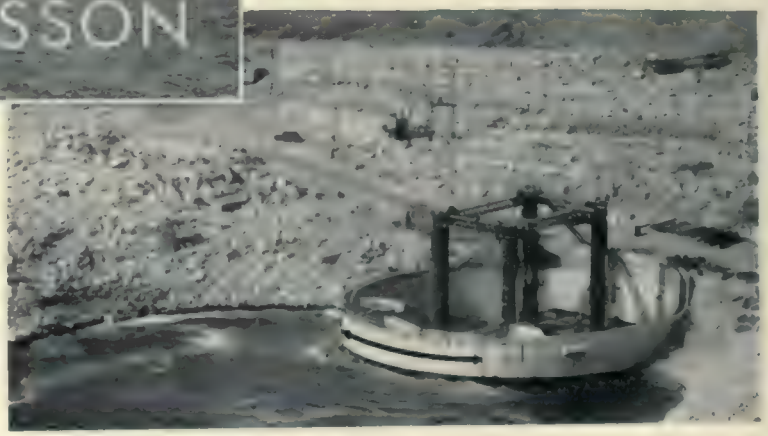
The gleam of hope in the eyes of many of the applicants who were present slowly died as their chances grew slimmer. And as the last name was called, the disappointed filed slowly out of the hall. "Perhaps I'll be lucky when the Mesa homesteads are drawn," one was overhead to remark. Some of the unlucky applicants for Yuma project farms may be more fortunate when names are drawn in Yuma this summer for 54 farms, comprising nearly 5,000 acres, on the Gila project's Yuma Mesa Division just east of Yuma.

In addition to Snyder, Harman, Simons, Colvin, Van Mitchell, Kryger, and Ross, the Yuma Project homesteaders are: Charles Burrell, Thatcher, Ariz.; June E. Pritchett, Santa Ana, Calif.; Leslie G. Todd, Davis, Calif.; William Owen Hilton, Pacific Grove, Calif.; Alward F. Fenn, Safford, Ariz.; Arthur Edward Martin, Tulelake, Calif.; Charles Cooper, Phoenix, Ariz.; Edward F. Conrey, Yuma, Ariz.; Lawrence G. Arnold, Orland, Calif.; Henry Charles Williamson, Jr., Sumner, Wash.; Alfred Maharry, Tulelake, Calif.; Albert Snyder, Somerton, Ariz.; James P. Richardson, Van Nuys, Calif.; Frank E. Brown, Compton, Calif.; Creighton Briggs Eggleston, Shedd, Oreg.; Albert R. Face, Yuma, Ariz.; Wilford Leo Allen, Tolleson, Ariz.; Wesley A. Davis, Somerton, Ariz.; Roy E. Freeman, Wilder, Idaho.

The above veterans, after filing applications for their homesteads, paying necessary filing and water fees, substantiating the data submitted with their applications and if necessary, appearing personally before the board of selection, will set up housekeeping on Yuma project homesteads on this, the oldest reclamation development on the lower Colorado River. END



Left: Close-up of circular drydock at Coulee Dam with floating caisson stored inside. Barge part of caisson has been raised to top of access shafts, in position it will occupy when caisson is in place on concrete of spillway of the dam. One section of drydock (see arrows) will be cut loose and dropped into the river to permit caisson to be floated from drydock. Below: View of circular drydock at Coulee Dam, showing partially floating caisson inside. *Photos by F. B. Pomeroy, Region I.*



THE FLOATING CAISSON of Grand Coulee Dam

by W. I. MORGAN

Hydraulic Engineer, Columbia Basin Project, Washington, Region I

The Columbia is a mighty river, for untold centuries free to cut and wear through the deep, hard lava beds and the great granite reefs along her way. The Grand Coulee Dam is a mighty structure which stands squarely across her path demanding toll before she can move on.

Grudgingly, the Columbia puts her "shoulder to the wheel" of the giant turbines and growls and whines as she spins out the power to light the million lamps of distant cities and to drive the gears of industry. That part of her which cannot squeeze through the whirling turbines must pass over the long spillway and tumble to the river below the dam.

The Columbia has left her mark on man's largest masonry dam. During construction days, when the flow of the river was shifted from side to side to permit work to continue, powerful cross-currents tossed big boulders and gravel into the spillway bucket. (See RECLAMATION ERA, February 1947.) Like millstones, these wore down sections of the bucket.

But like the boisterous Columbia, man is cunning, too. When the winter season of lowest flow occurs on the river, man will set forth with ingenious tools to repair the damage.

These tools which will permit workmen to labor in normal atmospheric conditions beneath 70 feet of icy water are of many kinds. The biggest and most important is the "Floating Caisson."

The floating caisson is built of structural steel, and weighs 1,300 tons. It has a curved bottom so that when it is taken to the toe of the spillway section of the dam and sunk, it will fit closely to the concrete surface on which it comes to rest. Rubber sealing strips contact the concrete surface. The working chamber, now about 70 feet below the river surface, can be pumped dry, and the repairs carried on at the eroded areas.

Each time the caisson is sunk and unwatered, 6,750 square feet of concrete surface will be accessible for repair. Repeated moving and sinking of the caisson will expose any area desired.

The floating caisson has two principal parts: the portion which can be sunk beneath the river surface to the concrete below, and the barge which remains afloat. Four hollow shafts, seven and one-half feet in diameter, extend above the river surface at all times and connect the barge with the working chamber. In two of these steel shafts is duplicate pumping machinery for unwatering the working chamber, a third shaft houses an electric elevator to carry men to and from the interior, and the fourth is a clear hoistway for passage of construction materials. The barge is confined within the area between the shafts, and operates on guides mounted on these shafts.

The hull of the barge is twelve feet deep. Hoisting equipment is mounted on the deck, and the necessary electrical

equipment is in the hull. The barge and the sinking portion are connected with heavy cables so the working chamber can be lowered slowly to the concrete surface, or raised, floated to a new position, and again sunk.

The caisson lies so deeply when afloat that at least 30 feet of water is required for safe movement. Before the caisson could be constructed at the Grand Coulee Dam, a circular concrete drydock sufficiently large to contain it was built. The drydock has a huge gate, 55 feet high, which opens to let the caisson in or out.

During the flood season of the river, the caisson is placed in the drydocks and sunk for protection from the force of the swirling waters. The drydock, with the sunken caisson inside, is often also submerged completely during June and July.

Maneuvering an unwieldy 1,300-ton combination barge and working chamber will prove to be a ticklish job on the Columbia. Although it is tamer during the low-water season, it still must be considered treacherous. Powerful winches, permanently located on the river banks and at each end of the 1,600-foot spillway with heavy cables attached to the caisson, pull it to the desired place. Radio communication to the operator of each winch will coordinate all movements.

This big repair job on the spillway bucket of the Grand Coulee Dam is not a simple one nor a short one. The work may require 10 years to complete. END

Top photo: Working model of the floating caisson in its test tank at Coulee Dam. Note: Bottom of caisson has been curved to fit spillway bucket snugly. Before being seated, it will be moved slightly to the left for proper fitting. ***Photo by H. Wayne Fuller, Region I.*** **Above: Water, during flood season, covers caisson and circular drydock. Former had been anchored to latter and its barge part had been lowered and filled with water. When in working position at the spillway, caisson will appear similar to this photo except its barge will be above water.** ***Photo by F. B. Pomeroy, Region I.***

School Was *NEVER* Like *THIS!*

•

by Wayne L. Smith

Instructor, "Veterans On-the-Farm Training Program," Heart Mountain Division, Shoshone Project, Wyoming

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"School was never like this," was the comment of a veteran homesteader taking "on-the-farm" training at Heart Mountain, Shoshone project, Wyoming.

If I had been a little doubtful about how the instruction had been received, my confidence was restored by this remark. We had tried from the beginning to get away from the atmosphere of formal schooling or teaching farming from a book.

The average veteran had been told what to do, and how and when to do it, for so long that it would have been a mistake to set the training program up on a formal basis. The many remarks I had heard farmers make about "book farming" and those who taught farming from a book—all of them far from complimentary—came to mind. The realization that, to a large extent, this attitude is justified, influenced the decision to make the training as informal as possible but not informal enough to develop into a common "bull session."

I received a homestead in the drawing held at Powell, Wyo., in February 1947, to establish priority of selection on 83 units open for settlement at that time on the Heart Mountain Division of the Shoshone project. In July I accepted the job of instructor of Institutional On-the-Farm Training under Public Law 346, commonly known as the GI bill of rights, and placed myself in the embarrassing position of trying to tell my neighbors how to farm.

It is an unwritten law of long standing that you do not tell your neighbors how to farm, not if you want them to have a neighborly feeling toward you. It is one thing for a county agent or vocational agriculture instructor to offer advice. It is something else for a farmer to tell other farmers how to farm, until he has demonstrated over a period of 15 or 20 years that he knows what he is talking about. The only way I could get out of this difficult situation and still draw my salary, was to call on others to do the telling. This was perhaps a cowardly way out, but it has, I believe, resulted in a training program that will compare favorably with any GI training class in the State.

The "on-the-farm" training program was established to enable qualified veterans to receive institutional training in agricultural practices. The veterans are eligible for one year of training plus an additional month for each month spent in the armed forces not to exceed four calendar years.

The author adds a light note to a serious topic which is enjoyed by Governor Lester C. Hunt, of Wyoming, Region VI, Regional Director Kenneth F. Vernon, and Mayor Ora Beaver, of Powell, Wyo.

Smith receives undivided attention as he leads classroom discussion on latest developments in farming practices. This may not be the last word in classrooms but it's the up-to-date instruction that counts.

V. C. Condie demonstrates technique of using power saw to veterans in the shop room. Machine-age farmers must be mechanics these days.

All photos by T. R. Broderick, Region VI

During the training period, subsistence payments to veterans enrolled in the agricultural courses are provided by the Veterans' Administration.

The veteran homesteaders at Heart Mountain have all had some farm experience, but having come from all parts of the country many of them have never had experience in irrigation. Much of the knowledge they had acquired could not be applied here because of the difference in soil conditions, climate, length of growing season, and crops grown.

The most logical place to look for practical information was among the farmers in the area—older settlers who had learned from experience and had demonstrated their knowledge by specializing, to some extent, in a particular farm enterprise and making a success of it. The old saying that experience is the best teacher is perhaps more applicable to farming than any other vocation. But why not learn from the experience of others?

With this in mind, a great part of the instruction program now in force has consisted of informal talks by experienced farmers who have been very cooperative in volunteering their time and services. Usually such talks are followed by general discussions. A particular effort has been made to use specialists from the University of Wyoming when they are in this area. Visual instruction, proven by educational leaders to be a very effective means of teaching, also helps to relieve the monotony of lectures. This part of the training is carried out by the use of educational films available from various companies, and film libraries of the University of Wyoming and Colorado State College. Films are available that deal with many phases of farming.

The Vocational Division of the Wyoming State Department of Education, which supervises the training, was fortunate in obtaining the services of another instructor experienced in shop work. About one-third of the 200 hours of classroom instruction required per year is devoted to shop instruction. Although equipment is far from adequate, a number of useful articles such as hog and brooder houses, gates, cabinets, feeders, and saw filing clamps, have been made by the trainees. Several automobiles and trucks have been overhauled in the shop which was formerly the school shop for the Heart Mountain Relocation Center. Two electric welders were recently secured for instruction in welding—a knowledge necessary on any farm.

Another phase of instruction, still in the planning stage, is the construction of precast concrete irrigation structures. The engineers and settlement specialists with the Bureau of Reclamation are cooperating in designing and testing the structures. A number of these structures are being tested at the present time. Those that meet the requirements and prove satisfactory will be made in quantity in the shop for use by the trainees on their homesteads.

The "on-the-farm" part of the instruction consists of demonstrations of improved practices and crop, feeder, and dairy tours to observe practices actually in use. Special emphasis has been placed on planning the farmstead. No greater opportunity has ever existed to plan a farmstead for economical operation than on the new homesteads where all the improvements are yet to be made.

All parts of instruction are strictly informal and flexible to meet emergencies. The home of one of the trainees recently burned and the class volunteered to move a section of one of his barracks to his farm and spend three days making it over into a four-room house. This will be done according to a drawn plan. It is hoped that this will serve as an example of how the barracks from the former Heart Mountain Relocation Center can be made into practical farm homes.

Special mention should be made of the cooperation received from the County Agent, F. H. A. County Supervisor, Bureau of Reclamation Settlement Specialists, A. A. A. representative, and representatives of other agencies. Their services have helped immeasurably in improving the on-the-farm training program at Heart Mountain. END

A New Killer for Water Weeds

(*Continued from page 83*)

trials that snails found in streams and irrigation canals in this country were even more susceptible to the new formula than waterweeds, thus the snail population could be eliminated directly. The Egyptian Government has already asked for information on the new formula for the dual purpose of controlling waterweeds and snails. It also has possibilities for killing mosquito larva and crayfish. The burrowing habits of the latter have caused the washing out of structures in some irrigation systems.

A word of caution: The new formula is inflammable and should be kept away from open flames. Also, avoid excessive breathing of the naphtha fumes. The naphthas may cause trouble to the skin through prolonged or frequent contact but you can avoid this difficulty by a thorough washing with soap and water. From the few preliminary tests made to determine the effects of the naphtha-treated water on crop plants, no injury was observed at concentrations used for controlling waterweeds. However, a more comprehensive study is now being made in the field and in the greenhouse, and pending the results of these investigations it is suggested that the use of treated water for irrigation purposes be avoided as much as possible.

Dr. R. S. Rosenfels, plant physiologist, formerly with the Bureau of Plant Industry, Soils and Agricultural Engineering, was stationed at the Bureau of Reclamation chemical laboratory in Denver during the laboratory tests described in this article. Equal credit is due him and the Reclamation chemists for the initial discovery of the value of the naphtha compounds for controlling waterweeds.

PHYSICAL PROPERTIES OF THE NEW MIXTURE DISCUSSED IN THIS ARTICLE

The material is predominantly aromatic and may be of either coal-tar or petroleum origin. It is composed of the higher homologues of benzene, not more than 10 percent of which shall have a boiling point below 287° F.

Flash point °F. not less than	87
Aniline point minus °F. lower than	30
Kauri-Butanol value, ml. higher than	80
ASTM D-86 distillation °F.:	
Starting point	278
Not more than 10 percent at	286
Not less than 90 percent at	385
End point, not higher than	420

For an emulsifying agent the use of mahogany soap of approximately 5 percent by volume is recommended and should be thoroughly mixed prior to application.

The physical properties listed above can be used as a specification for purchasing the material.

IRRIGATION in the Province of Alberta, Canada

Western Irrigation District Dam on Bow River at Calgary, Alberta. Photo courtesy of H. Pollard, Calgary, Canada.

by P. M. SAUDER, Colonization Manager, Department of Water Resources, Government of the Province of Alberta, Canada

Alberta is blessed with thousands of acres of fertile soil, but parts of the southern portion of the Province suffer from a lack of sufficient rainfall. Not only is precipitation relatively light but it is also variable, unreliable, and unpredictable. It fluctuates above and below the critical point for crop production and even a slight decrease in amount from one year to the next may seriously reduce the yields of unirrigated crops. Withering drought, possible in any year, may destroy dry land crops over wide areas. As a result, agriculture is not reliable in Southern Alberta except where irrigation is available.

There are, however, individuals and corporate bodies operating large wheat farms quite successfully even when wheat is selling at its lowest price. With up-to-date power machinery, it is possible to produce wheat on large areas at a small cost per bushel. Usually these larger farmers only crop half of their land each year and summerfallow the other half. The summerfallow conserves the moisture and they have practically two years' moisture to produce one crop. By this method, they are almost sure to have a fairly good yield.

The story of the man with one quarter section or a half section is different. He cannot produce wheat nearly as cheaply because he cannot buy the large economical machinery and his acreage is too small for economic farming. He usually falls behind and gets deeper in debt until finally he loses his land and the large farmer buys it at a low price. The small farmer is disappearing from the semiarid areas and is being replaced by a few successful and prosperous large farmers.

There are also large areas occupied by cattle and sheep ranchers who help to produce a lot of the wealth of the Province but in the semiarid regions they are replacing the small farmer, with the result that the population is decreasing and there are large areas so sparsely populated that it is impossible to maintain schools and improve roads. Here again, the small farmer cannot make a decent living.

The primary purpose in providing irrigation is to increase production and eliminate the hazard of drought and crop failure. The control of moisture through irrigation affords a high degree of stability in production which gives irrigation an important advantage over dry land farming. This advantage is fully demonstrated by the greater density of population, adequately supported on irrigated as compared to dry land by the thriving agricultural communities, and the prosperous urban centers in the irrigated sections. Irrigation provides for a wide diversity of crops and for the growing and feeding of livestock. It provides opportunity for home building, for maintaining a higher standard of living, and for improved educational facilities and social advantages made possible by a greater density of population.

The marked increase in the density of population where water is made available for crop production, for home building, and the growing of food in large and certain quantities, thereby maintaining a high standard of living, is no doubt the major benefit of irrigation, and is shown in a comparison of population under dry-land and irrigation conditions in Alberta.

The census returns for 1936 show the number of persons in wholly dry farming areas east and south of Lethbridge as averaging 3.5 persons per square mile. The partly irrigated areas averaged 12.7 persons per square mile, and the irrigation areas averaged 29.7 persons per square mile. The tendency is for the density of the population to increase in the irrigated areas and to decrease in the dry farming areas. The specialized crops such as sugar beets mean smaller farms and more help, often two families on a farm.

Industrial developments resulting from irrigation are contributing in a very substantial measure to the general welfare of southern Alberta and to Canada as a whole. The main developments of this nature include sugar beet factories, canning factories (where a wide assortment of products are processed), seed cleaning and grading plants, alfalfa meal mills, commercial apiaries, cheese factories, and plants for producing dairy, meat, and poultry products.

Some 508,600 acres of land are actually served by existing irrigation works of the 11 larger projects in southern Alberta and there are about 5,000 irrigation farmers operating on this area. In addition, there are a large number of small projects operated by the owners of the land. In all, about 70,000 acres can be irrigated by these small projects.

The area that can be irrigated is much greater than the supply of water available will irrigate, and further development must be based largely on storage of high and flood waters of the streams. Large quantities of water flow down the streams in the spring and early summer which should be stored in reservoirs and spread on the land later in the season when the crops are suffering from drought.

Our Governments, Federal, and provincial, which of course only carry out the wishes of the people, have been slow to realize the great advantages of irrigation in the past. It looks now, however, as if works will be constructed in the near future to serve a considerable additional area. In fact construction has already started on works to serve an additional 345,000 acres in the St. Mary and Milk Rivers drainage basins at an expenditure of about $20,000,000. A program involving an expenditure of $100,000,000 in 10 years is also being seriously considered. This, however, is only a small program when compared with the program of the Bureau of Reclamation.

Irrigation has, of course, been practiced in the United States much longer than in Canada and to a much greater extent and Canadian engineers engaged in irrigation work have learned a lot from their American cousins. Our visits to the United States have been very limited in recent years because of the War. However, C. S. Clendening, district manager of the Lethbridge northern irrigation district and G. S. Brown, assistant manager, St. Mary and Milk Rivers Development and I seized an opportunity to pay a hurried visit to irrigated areas in Wyoming, Colorado, Nebraska, and Montana. Here are a few comments on our observations.

The crops grown with irrigation in Alberta are similar to those grown in the four States visited. Alberta is further North but our irrigated areas are only 2,900 to 3,200 feet above sea level. The irrigated lands in the four States visited are at much higher altitudes.

The United States projects have more drains than Alberta projects, largely because the irrigated land in the United States projects is valued considerably higher and more drainage is provided to prevent loss of the use of the land through seepage, waterlogging and alkali. More of the canals on the United States projects are lined with concrete to prevent leakage and consequent damage to the land.

Manner of Financing the Larger Irrigation Projects in Alberta

In the early stages of irrigation development in Alberta, those who settled on the land were expected to pay the total cost of the construction of the irrigation works, but it was found that while irrigation enabled them to produce more and better crops, the water charges were too great a burden.

The cost per acre varied greatly on the different irrigation projects. The total capital charges due to irrigation have varied from a few dollars per acre in the case of the Mountain View project to $55 per acre in the Lethbridge Northern. The annual charges, for capital costs, maintenance and operation varied correspondingly, from 30 cents per acre to $5.25 per acre. Some of the higher rates were later reduced. Summaries of the charges made on some of the typical projects will be given hereunder.

St. Mary and Milk Rivers Development

This, the first large project undertaken, was constructed by the Alberta Railway & Irrigation Co. to irrigate a tract of land owned by the company and lying south and east of the site of the present city of Lethbridge. Most of the land was sold at $5 per acre for the land and $35 per acre aditional for a water right for the areas that could be irrigated. Payments were usually on a crop share basis of one-fifth of the sugar beet crop, one-third of the other crops, and 6 percent interest per annum on the unpaid balance of the purchase price. Some difficulties were experienced during the periods of low prices for farm produce but most of the purchasers have paid up and the proceeds from the sale of the water rights have reimbursed the company for the cost of the construction of the works. The service charge, amounting to $1 per irrigable acre, is a first charge against the crop share for the operation of the main and large branch canals. The farmers operate their own distribution works individually or cooperatively at a cost of 25 cents per irrigable acre.

Eastern Irrigation District

A large portion of the irrigable land on this project, which lies east of the city of Calgary, was held by farmers under agreements to purchase from the Canadian Pacific Railway Co., builders of the works, at prices ranging from $25 to $40 per acre, when the project was transferred to the farmers. Subsequent to this transfer all contracts were adjusted and reduced to approximately one-fifth of the original amounts. The water service charge levied by the irrigation district has varied from $1.00 to $1.75 per irrigable acre but there has been no levy for the water right.

The railway company really recovered very little of the cost of the works and also absorbed deficits in operation and maintenance during the period that it operated the works before they were transferred to the farmers. The railway company did not, however, suffer seriously because of the increased railway traffic after irrigation was started.

Lethbridge Northern Irrigation District

This project serves a semiarid area north of the city of Lethbridge, which, when the project was constructed, was privately owned and used for wheat growing. The owners formed an irrigation district and sold bonds, bearing 6 percent interest and guaranteed as to the payment of interest and principal by the government of Alberta.

Because of the high construction costs prevailing when the project was developed, the cost of the works averaged $55 per irrigable acre. In 1924, the first levy was $1.48 per irrigable acre for water service charges and $3.77 per irrigable acre to pay interest, exchange, etc., on the bond issue (water right payment), a total of $5.25 per irrigable acre. It soon became apparent that the farmers could not pay these rates and an appeal was made to the provincial government for assistance.

In 1925, the government gave temporary financial assistance but the matter had to be reconsidered and in 1930, the provincial government assumed part of the construction cost and part of the water service charges.

During the early thirties when the prices of farm produce were very low, further assistance became necessary and the Government assumed an additional portion of the construction costs, leaving $17 per irrigable acre for the water right to be paid by the settler. The service charge has been set each year according to requirements and has averaged $1.25 per irrigable acre per annum. The farmers growing sugar beets and other specialized crops have not had much difficulty in meeting these payments, but when grain only is grown, payment has been difficult.

Taber Irrigation District

This is the first irrigation district erected under the present Irrigation Districts Act. It serves an area of privately owned land east of the city of Lethbridge and adjoining the town of Taber. The original works cost an average of $16 per irrigable acre. This cost was later reduced to $12.59 per irrigable acre by serving an additional area with works that cost less per acre than the original area. The rate of interest on the unpaid balance was originally 6 percent per annum, but this was reduced to 5 percent per annum in 1935. The annual payments for water right and service charges have varied from $1.50 to $2.60 per irrigable acre and averaged slightly less than $2 per irrigable acre.

This district has proven an outstanding success because the farmers went in for growing specialized crops as soon as possible and because of the low capital and operating costs.

Summary of Repayment Practices

The story of these four projects is sufficient to show the varied experience in financing irrigation projects in Alberta. Some of the inability of the farmers to pay the capital cost of the works is due to the reluctance of the settlers to abandon straight wheat growing and go in for diversified and specialized crops. It, however, takes time and experience to change from dry land farming to irrigation farming and experience has demonstrated that the settler should not be saddled with high water right (levy for costs of works) and service charges. He should also receive assistance in preparing his land for irrigation and expert advice in his farming program.

In view of past experience, there is no doubt that the future settlers will get a better deal. It is proposed but not yet agreed that the new settler should receive water service free of charge for 1 or 2 years and that his land should be leveled free of charge. Also that the water right payment should not exceed $10 to $15 per irrigable acre, that payments should not start until the third year and that the rates of interest payable on the unpaid balance should be very low. In order to achieve these low rates, the Federal Government will construct the diversion dam, the main canal, the storage reservoirs, and connecting canals as a contribution to irrigation. The provincial government is to construct the distribution system, provide the free water service and the agricultural advice, level the surface of the irrigable land and only charge $10 to $15 per irrigable acre payable at the rate of 50 cents per acre per annum for the water right. It is agreed that the balance of the capital cost and free services should be paid out of the general revenue of the province.

The organization, administration, and management of irrigation districts in Alberta is similar to that of irrigation districts in the States visited. Any area in Alberta where the irrigation works can be operated as a single unit may be outlined as an irrigation district and obtain the right of self-government in the maintenance and operation of the irrigation works in that area. The business of an irrigation district is supervised by a board of trustees elected by the water users of the district. The board usually employs a professional engineer, experienced in irrigation work, to obtain and direct the necessary help to maintain and operate the irrigation works.

While we were a little hurried, we enjoyed our trip and found it very interesting and instructive. All officials of the Bureau of Reclamation and the irrigation districts were very courteous and obliging and we wish in closing to express our thanks to them. We particularly enjoyed a day that was spent in the Bureau's offices and laboratories in West Denver.

END

The PARSHALL Measuring Flume

by RALPH L. PARSHALL

The water measuring device called the Parshall measuring flume was developed at the hydraulic laboratories of the Colorado Agricultural Experiment Station, Fort Collins, in cooperation with the United States Department of Agriculture.

The first experiments were conducted in 1915 by V. M. Cone, who was then in charge of the cooperative irrigation investigational work in Colorado.

This device, in its original inception, consisted of three parts—converging, throat, and diverging sections. When viewed from above, the structure resembled somewhat an hourglass. The upstream converging and downstream diverging sections were identical in taper and similar in dimensions. These two sections were joined by a throat having a length of one foot in the direction of the flow of water. The walls of the structure were vertical and the floor was level throughout.

The original tests were confined to structures having throat widths of 1, 2, and 3 feet and capacity of discharge of about 15 second-feet for the larger flume. This measuring device was at first known as the Venturi flume. The name "Venturi" was rather appropriate because of the identity of the general principle or law underlying the hydraulic relations of the flume and the Venturi meter perfected by Clemens Herschel in 1887. In 1797 Giovanni Battista Venturi, an Italian engineer, experimented with the flow of water through tapering tubes and about 100 years later Herschel adapted the findings of Venturi to perfect the Venturi meter for measuring the discharge of water under pressure in pipe lines. The Venturi flume, where the flow of water is measured in a channel, fully exposed to atmospheric pressure, was the next step.

The original design of the Venturi flume, having equal angles of convergence and divergence, and a relatively short throat section, was found by further experimentation to be not wholly satisfactory. To correct certain inconsistencies in the law of discharge, alterations in the design were suggested as based on these later experiments. The improvements consisted in the change of the angle of convergence from 18°26′ to 11°19′, also the angle of divergence from 18°26′ to 9°28′, increasing the length of the throat section and introducing a downward sloping floor in the throat of the structure. These alterations resulted in having the downstream end of the floor of the diverging section lower in elevation than the crest—which is the line joining the level floor of the converging section and the throat floor. These improvements were made in 1926. After fully verifying this new design, calibrations were made on flume sizes ranging from 6 inches to 8 feet and the results published under the title of "The Improved Venturi Flume."

Mr. Parshall and his flume.

THE AUTHOR

By FRANK J. SHIDELER, Colorado A. & M. College, Fort Collins, Colo.

Ralph L. Parshall, who retired February 1, 1948, has gained world-wide fame as an irrigation engineer while serving with the United States Department of Agriculture stationed at Colorado A. & M. College. He is a native Coloradan and spent his boyhood in the mining region near Idaho Springs.

Parshall was born in Golden, Colo., July 2, 1881, and graduated with honors from Colorado A. & M. in 1904 with a degree of bachelor of science in civil engineering. From 1904 to 1912 he worked for Colorado A. & M., first as an instructor and later as associate professor in the civil and irrigation engineering department. In the summers of 1906 and 1907 he attended the University of Chicago, taking special work in physics, mathematics, and astronomy. He began work with the United States Department of Agriculture in the Irrigation Investigation Section in February 1913.

The Parshall flume, one of his best-known contributions, was the result of many years' work to devise a solution to the problem of measuring and distributing irrigation water to farmers. It was developed in the early 1920's and soon was adopted on a world-wide basis.

Sand traps for removing silt from irrigation canals, designs of recorders of water stages and integrators, surveys on return seepage water from rivers, snow surveying as a basis for forecasting irrigation water run-off, preliminary economic surveys for the Colorado-Big Thompson project, bulletins on water measurement and irrigation subjects—these, and many more subjects have been a part of the work Ralph L. Parshall has accomplished during his 35 years of valuable service in irrigation.

He continues to maintain a desk in the Engineering Building on the Colorado Aggie campus, working on studies of particular interest to himself. He plans to continue in the role of consultant in trying to assist anyone who has a problem connected with irrigation.

In between times, Parshall devotes more time to his chief hobby—painting.

"Rendering a service to the public is the finest thing I can accomplish," says Parshall of his long association with irrigation. "The State of Colorado gave me an education, and what I have accomplished I hope will serve as some compensation for that education."

Mr. and Mrs. Parshall plan to continue living in Fort Collins in the same home they moved into in 1907. END

Through a recommendation of the Committee of the American Society of Civil Engineers on Irrigation Hydraulics, 1930, and with the approval of the cooperating agencies under which this device was developed, the name was changed to the Parshall measuring flume.

The need of a more practical water measuring device was recognized prior to the first experimental work on the Venturi flume by Cone in 1915. The simple weir of relatively small size suitable for measuring the flow in a farmer's lateral, was almost universal in its application for farm deliveries. Many such weirs were installed in these laterals where the grade of the channel was flat and high submergence resulted at the time of the measurement of the flow. It was of course obvious that with a high water surface downstream from the structure the rate of flow would be less than if no submergence existed. Because of limited data for calculating the discharge when submerged, or just plain indifference on the part of the operator, the head on the weir was taken as the index of flow whether the condition was submerged or free discharge. Other factors regarding the setting of the weir structure, which affected somewhat the discharge, were often given no consideration and on the whole the weir was finally regarded as impractical under general farm practice. Farm deliveries usually range from 1 to 10 second-feet.

The problem of measuring canal and ditch diversions from streams or reservoirs where the flow might range from 10 up to 800 or 1,000 second-feet or more presented a condition or requirement exceeding the application of the weir for this purpose. Since the time of the adoption of State water laws, regulating the diversion by decreed rights from streams, the ordinary rating flume had been recognized as the official measuring device. Such a structure, either wood or concrete, was of varying length depending on the amount of water to be measured and the width and depth of the channel. Such a flume generally would be 12 to 16 feet long, 20 to 30 feet wide, and 4 to 5 feet deep with a level floor and either vertical or outward inclined side walls. A simple graduated scale in feet was attached to the wall indicating the depth of water. By means of a current meter the discharge in second-feet was measured and the depth on the gage staff noted. Measurement of different rates of flow and the corresponding depths permitted the fixing of a rating curve for the particular flume. Theory pointed out that as the depth increased the rate of discharge was proportionally more. For stabilized channels this relation was true. In irrigation practice, however, experience pointed out that it was often the case that sand and silt accumulated in the bed of the channel and on the floor of the rating flume to the extent of having the water depth on the staff gage increased and the actual discharge decreased. Sometimes scouring would occur and the reverse would be true; that is, more water at a lesser depth. Checks in the channel, weed, moss, grass, willows, and other causes in combination resulted in questionable indicated rates of discharge. Some canals, 600 to 800 second-feet in capacity, have been found to vary as much as 100 second-feet for the same indicated staff reading in a few hours, such a condition being due to scouring out or filling in with bed sand.

The development of the Venturi principle into what is now known as the Parshall measuring flume has been the means of correcting many of the evils of the past. Over the years the flume has been perfected in various details and now may be recommended for use. Small flumes having a 3-inch throat will measure accurately to a minimum of about 0.01 second-feet. A 40-foot flume has been in operation in the Fort Lyon Canal, near La Junta, Colo., since 1928, with a capacity of more than 2,000 second-feet. Nominal capacity of this canal is 1,600 second feet.

The 3-inch flume is best suited for experimental work in measuring delivery and waste from agricultural irrigated field plots. Flumes ranging from 1 to 4 feet are suitable for ditches and laterals, while for canals the size of structures varies from 8 to 40 feet. The 6-, 9-, 12-, and 18-inch flumes are best adapted to the measurement of farm deliveries from ditch or lateral.

The recent development of the portable form for casting small-sized flumes—3-, 6-, and 9-inch monolithic reinforced concrete structures—has made it possible to build these at a very reasonable cost.

The flumes may be made of either metal, wood, or concrete. Metal flumes are generally of the smaller sizes while the large structures are made of reinforced concrete.

Since 1926 the use of this measuring device has been rather extensive and it is found serving a useful purpose in practically all the irrigated areas throughout the world. The flume was intended for irrigation practice but because of certain advantages it was found to be useful in the field of sanitary engineering and industrial plants, particularly paper mills.

Much of the success of this measuring device is to be credited to Mr. Carl Rohwer, who assisted in conducting laboratory and field experiments, preparing the text of bulletins, diagrams, tables, and illustrations of various kinds, all having to do with the successful adoption of the flume in serving a useful purpose in the field of irrigation and elsewhere in meeting the problems of water measurement. One other thing should be mentioned in connection with the success of our flume. It was not a one-man job. Credit is due to Dr. Charles A. Lory and Director C. P. Gillette, both of whom gave constant encouragement and had faith in the work which finally proved out. Also, to S. H. McCrory, formerly Chief of the Bureau of Agricultural Engineering and Mr. W. W. McLaughlin, formerly Chief of the Division of Irrigation, my supervisors. These four men did much in promoting the success of our work in the laboratories and field. As for myself, I lay no claim as the inventor. My contribution was to correct the design and promote the use of this measuring device. For further reference, those interested might consult the following bulletins:

The Venturi Flume, by V. M. Cone. An extended report appearing in the Journal of Agricultural Research, Vol. IX, No. 4, April 1917.

The Venturi Flume, by R. L. Parshall and Carl Rohwer. Bul. 265, 1921 Colo. Agri. Expt. Station publication.

The Improved Venturi Flume, by R. L. Parshall. Bul. 336, 1928 Colo. Agri. Expt. Station publication.

Parshall Flumes of Large Size, by R. L. Parshall. Bul. 336, 1932 Colo. Agri. Station publication.

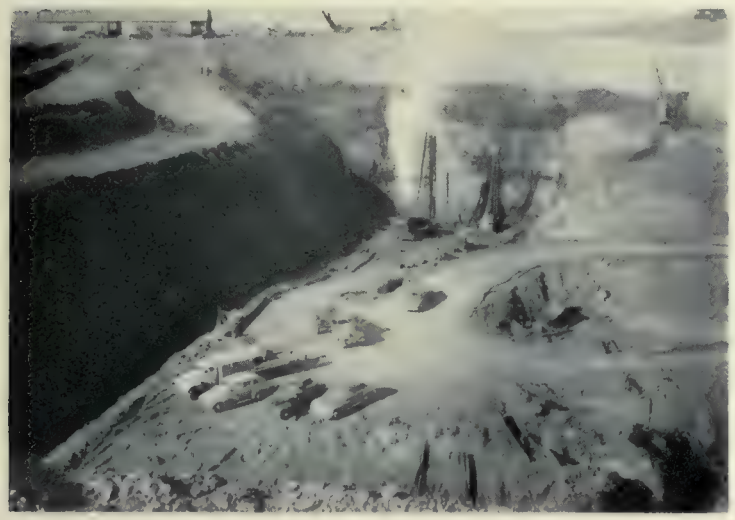
Measuring Water in Irrigation Channels, by R. L. Parshall, Farmer's Bul. 1683, 1932, Rev. 1941, U. S. Dept. Agri. publication. This bulletin is to be again revised soon, possibly during the latter part of 1948.

Improving the Distribution of Water to Farmers by Use of the Parshall Measuring Flume, by R. L. Parshall. Bul. 488, 1945 Colo. Agri. Expt. Station publication.

END

News Round-up

Tracy Pumping Plant—"Heart" of CVP—Now Under Way



Construction crews near Tracy, Calif., are digging a hole large enough to accommodate Hoover Dam. This activity is part of the Central Valley project. To be specific, four and one-half million cubic yards of earth will be excavated and removed in order to permit the construction of the 2⅓ mile intake canal and the giant Tracy pumping plant, "heartbeat" of the Central Valley project. This plant is the connecting link between the water resources of the Sacramento Valley with those of the San Joaquin Valley which makes the Central Valley project possible. The above photograph, taken by W. J. Heron, shows a general view of the excavation with pile-driving operations in progress at the far end. See RECLAMATION ERA, page 213, October, and page 257, December, 1947, for details on plan and bid opening.

New "Land Economics" Includes Housing

Land Economics is the new title of the almost 25-year-old Journal of Land and Public Utility Economics, a quarterly published by the University of Wisconsin.

The February issue was the first to appear bearing the new title. While the editorial policy will remain the same, the board is adding subject matter on planning and housing as fields of scientific interest, and has incorporated a subtitle "A Quarterly Journal of Planning, Housing, and Public Utilities."

Robbins Named Regional Director

Howard E. Robbins who has been serving as Acting Regional Director of Region V, Amarillo, Tex., since his predecessor Wesley R. Nelson became Assistant Commissioner, was recently named Regional Director.

He has jurisdiction over the reclamation developments in Texas, Oklahoma, most of New Mexico, and parts of Kansas and Colorado. More than 1,500,000 irrigable acres of farm land are included in authorized projects, in various stages under his supervision. Among the projects in his region are the Rio Grande and Carlsbad, two of the most early reclamation developments, and the W. C. Austin in Oklahoma, which enjoys the distinction of being the easternmost Federal irrigation project in the Nation.

Robbins, a career employee, joined the Bureau in 1916 and worked his way up through the ranks. Among some of his more important previous assignments were as project engineer, Valley gravity project, Texas, construction engineer, W. C. Austin project, Oklahoma, office engineer on the Colorado Big Thompson project, Colorado, and Salt River project in Arizona, and a period of service in the designing section of the Office of the Chief Engineer, when Hoover Dam was designed.

Club Presents Technical News

The first issue of the *Technical News*, a non-Government publication of the Reclamation Technical Club appeared in February of this year. Subscription rates are $1 per year, or to members of the club 75 cents, which is included in the annual dues of $1. Requests for memberships or subscriptions should be mailed to Secretary, Reclamation Technical Club, P. O. Box 2582, Denver 15, Colo.

Sugar for the Freedom Train

Belle Fourche project farmers donated an entire carload of sugar to the Abraham Lincoln friendship train for European relief.

World Relief Day was held on February 7, 1948, in the town of Newell, S. Dak., to raise money to contribute to the relief train, which started from Lincoln, Nebr., on Abraham Lincoln's birthday. The train moved east through Iowa and Illinois to Chicago where the South Dakota cars joined the train. The organization responsible for the South Dakota participation was South Dakota World Relief, of which Dr. A. A. Schade is cochairman.

On World Relief Day at Newell, merchants and other citizens of the project donated articles which were auctioned off to the highest bidders in the afternoon. That evening Dr. Schade lectured on conditions in Europe and showed motion pictures which depicted the dire need of the European peoples. A well-attended benefit dance followed. Proceeds from the auction, the dance, and contributions totaled about $2,000—enough to pay for a carload of sugar. This money, combined with that raised in other parts of the State, resulted in eight carloads of food being sent to join the Abraham Lincoln friendship train at Chicago.

Dr. Schade contacted the Butte County Farm Bureau and service organizations in all of the project towns and it was through their cooperation that the World Relief Day was staged in Newell.

McClellan Succeeds Walker R. Young

Walker R. Young (left) and his successor, Leslie N. McClellan

Walker R. Young, Chief Engineer of the Bureau of Reclamation, Denver, Colo., will retire on June 30 upon completion of 37 years of service with the Bureau. L. N. McClellan, also of Denver, now Assistant Chief Engineer, will succeed him.

Secretary of the Interior J. A. Krug, commenting on Mr. Young's decision, said: "The retirement of 'Brig' Young is a great loss to western resource development. It will be ameliorated some by his consent to continue serving with the Bureau as a consultant on engineering matters.

"Mr. McClellan, who also began work with the Bureau in 1911, is another outstanding engineer with a lifetime background in Reclamation which thoroughly qualifies him to take over direction of Reclamation's design and construction."

Mr. Young's Reclamation career began as an engineer on the construction of Arrowrock Dam in Idaho, then the world's tallest dam. Ever since then, his work has been identified with structures and projects of unprecendented size, always requiring the utilization of the most current technical engineering skill. In 1921 he was assigned the responsibility of finding a site and of preparing designs and estimates preliminary to the construction of Hoover Dam and power plant. Later he served as construction engineer on this Dam, the highest in the world, (726 feet.)

He worked on numerous other first-magnitude planning, designing, and construction jobs such as construction engineer on the Kittitas Division of the Yakima project, Washington, and supervising engineer on California's huge Central Valley project. He became the Bureau's Assistant Chief Engineer in November 1940. In January 1945, he was appointed Chief Engineer. During his term in office, such structures as the 13-mile-long Alva B. Adams Tunnel in Colorado, world's longest irrigation tunnel; Davis Dam, on the Colorado River; the Tracy pumping plant, in the Central Valley project, California, and many other notable structures have gone forward.

Reclamation Commissioner Michael W. Straus commented. "Under his skilled engineering guidance, forces and work procedures organized to carry a construction program of less than $100,000,000 per year have been reshaped to carry, with a high degree of success, a construction pace now exceeding a quarter of a billion dollars per year."

Mr. McClelland was born in Middletown, Ohio, in 1888. He was graduated from the University of Southern California in 1911 with the degree of bachelor of science in electrical engineering, and shortly afterward began work for the Bureau on the Salt River project in Arizona.

Thus, Mr. McClellan brings to his new job a lifetime of experience in water-resource development as well as his technical background in hydroelectric development.

As Assistant Chief Engineer for the past 3 years, he has been closely associated with Mr. Young in directing the design and construction aspects of the broad Reclamation program. Upon Mr. Young's retirement, he will take over the responsibility for the design and construction phases of the Bureau's 22 active projects, involving contracts aggregating $260,000,000 in value.

Mr. McClellan is fellow and past Vice President of the American Institute of Electrical Engineers, and past chairman of the Denver section of the American Institute of Electrical Engineers, the Colorado Society of Engineers, and of the United States International Conference on Large Electric High-Tension Systems. He was a United States delegate to the World Power Conference in Paris in 1946. (See RECLAMATION ERA, February 1947.) END

NOTES FOR CONTRACTORS

Contracts Awarded During March 1948

Spec. No.	Project	Award Date	Description of work or material	Contractor's name and address	Contract amount
2027	Central Valley, Calif	Mar. 5	Construction of steel and precast concrete pipe for Tracy pumping plant	Stolte, Inc., Oakland, Calif	$2,552,302
2028	Missouri Basin-Canyon Ferry, Mont	Mar. 12	Construction of buildings and residences for Canyon Ferry Government camp	Dudley Construction Co., Great Falls, Mont	324,259
2030	Davis Dam, Ariz.-Nev	Mar. 19	Main control boards, battery chargers, unit substation, and transformers for Davis power plant, schedules 2 and 6	Westinghouse Electric Corp., Denver, Colo	320,608
2015	Columbia Basin, Wash	Mar. 5	3 5,000 ampere bus structures for units R1, R2, and R3, Grand Coulee power plant	I-T-E Circuit Breaker Co., Philadelphia, Pa	224,145
2021	Davis Dam, Ariz.-Nev	Mar. 29	3 30,000-40,000-kilovolt-ampere transformers for Parker switchyards, schedule 4	Allis-Chalmers Manufacturing Co., Denver, Colo	549,000
			12 circuit breakers and 7 lightning arresters for Parker switchyards, schedules 2 and 4	Westinghouse Electric Corp., Denver, Colo	693,061
2022	Klamath Dale Lake, Oreg.-Calif	Mar. 11	2 pumping units for pumping plants E and F, schedule 1	Crane O'Fallon Co., Denver, Colo	22,152
1926	Central Valley, Calif	Mar. 30	58 disconnecting switches for Tracy switchyard and Elverta substation, schedules 1, 2, and 3	Graybar Electric Co., Inc., Denver, Colo	242,268
2031	Missouri Basin-Canyon Ferry, Mont	Mar. 4	Construction of electrical distribution system at Canyon Ferry Government camp	Allen Electric Co., Helena, Mont	15,596
2035	Missouri Basin-Power Transmission Lines, Unit, Nebr	Mar. 3	6 transformers, 3 circuit breakers, and 7 lightning arresters for Sidney substation, schedules 1, 2, 4, and 8	Westinghouse Electric Corp., Denver, Colo	131,170
2037	Colorado-Big Thompson, Colo	Mar. 12	Six bulkhead assembly, spare circuit breaker removable element, line control board, and current transformers for Granby pumping plant	do	64,212

Contracts Awarded During March 1948—Continued

Spec. No.	Project	Award Date	Description of work or material	Contractor's name and address	Contract amount
2043	Missouri Basin-Power Transmission Lines Unit, Nebr.	Mar. 11	Transformers, step-voltage regulator, metering outfit, and lightning arresters for Bridgeport substation, schedules 1, 2, 3, 4, 9, and 11.	Westinghouse Electric Corp., Denver, Colo.	$191,156
		do	Circuit breakers for Bridgeport substation, schedule 6	General Electric Co., Denver, Colo.	45,912
		Mar. 12	Disconnecting switches and fuses and fuse cut-outs for Bridgeport substation, schedules 7 and 8.	A. B. Chance Co., San Francisco, Calif.	24,193
2051	Columbia Basin, Wash.	Mar. 5	Switch-gear unit, motor control boards, heating contractor board, battery control, board, distribution board, battery charges, and test cabinet for Grand Coulee right powerhouse, schedules 1, 3, 4, and 5.	Westinghouse Electric Corp., Denver, Colo.	143,141
		do	2 lighting and heating unit substations and 10 power unit substations for Grand Coulee right powerhouse, schedule 2.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	181,677
2053	Boise, Idaho	do	Completion of Anderson Ranch Dam and power plant	J. A. Terteling & Sons, Inc., Boise, Idaho	2,499,364
2058	Colorado-Big Thompson, and Missouri Basin, Colo.-S. Dak.	Mar. 12	1 fixed wheel gate and frame for Prospect Mountain conduit and 2 fixed wheel gate frames for Angostura Dam, items 1, 2, 5, and 6.	Johnson Machine Works, Inc., Chariton, Iowa.	23,655
2061	Columbia Basin, Wash.	Mar. 11	Control boards for units R1, R2, and R3 and 230 kilovolt Snohomish line, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	78,053
2062	Colorado-Big Thompson, Colo.	Mar. 25	1 unit substation with dry type transformers for Granby pumping plant, item 1a.	I-T-E circuit Breaker Co., Philadelphia, Pa	25,744
2066	Yakima-Roza, Wash.	Mar. 22	1 55-inch plate steel penstock and 1 38-inch plate steel pump discharge pipe.	American Pipe & Construction Co., Portland, Oreg.	80,585
2070	Fort Peck, Mont.	Mar. 31	Construction of McCone County Electric Cooperative (Circle) 1,700 kilovolt-ampere substation.	C-L Electric Co., Pocatello, Idaho	114,669
2071	Kendrick and Missouri Basin, Wyoming	do	Construction of Medicine Bow-Hanna and Glendo-Lusk 34.5 kilovolt transmission lines.	J. R. Foree, Topeka, Kan.	44,503
2075	Columbia Basin, Wash.	Mar. 26	Completion of control bay, control cable tunnel, and parking area for right power plant; and construction of transformer circuits, tie circuits, and right switchyard for Grand Coulee Dam.	Morrison-Knudsen Co., Inc., and Peter Kiewit Sons Co., Seattle, Wash.	2,789,284
2076	Klamath-Tule Lake, Oreg. Calif.	Mar. 5	Construction of earthwork for South Maine dike, B dike, and North Main dike.	Tyson & Watters Co., Sacramento, Calif.	35,867
2078	Boulder Canyon-All-American Canal, Ariz.-Calif. Nev.	Mar. 25	Construction of earthwork, wasteway lining, and structures for wasteways 2 and 3, Coachella Valley flood protection.	Macco Corp., Clearwater, Calif.	605,655
2082	Colorado-Big Thompson, Colo.	Mar. 23	6 butterfly valves and 6 grease pumps for Granby pumping plant, items 1, 2, and 4.	Premier Gear & Machine Works, Portland, Oreg.	128,090
2087	Missouri-Basin-Frenchman-Cambridge, Neb.	Mar. 3	Embedded metalwork for 6 radial gates at Enders Dam	Schmitt Steel Co., Portland, Oreg.	16,170
2092	Missouri Basin-Angostura, S. Dak.	Mar. 23	5 radial gate hoists for Angostura Dam	Monarch Forge and Machine Works, Portland, Oreg.	74,937
2095	Colorado-Big Thompson, Colo.	Mar. 26	1 108-inch diameter plate steel pipe for Horsetooth Feeder Canal.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	45,300
2100	Columbia Basin, Wash.	Mar. 23	3 sets of seal base assemblies for penstock coaster gates, Grand Coulee Dam.	Johnson Machine Works, Inc., Chariton, Iowa.	11,850
2102	Missouri Basin, N. Dak.	Mar. 31	High pressure gates, hydraulic hoists, gate hangers, conduit lining, and conduit lining transition for outlet works, Heart Butte Dam.	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	32,950
2111	Central Valley, Calif.	Mar. 24	Construction of warehouse building at Tracy pumping plant	Luther Adams & Giles N. Chittenden, Auburn, Calif.	39,030

Construction and Supplies for Which Bids Will Be Requested During May and June 1948

Project	Description of work or material
Boise, Idaho	Electric heaters and miscellaneous equipment for Anderson Ranch Dam power plant.
	Relocation of domestic water supply for village of Cascade, Idaho, and construction of a standby pumping unit.
Boulder Canyon, Ariz.-Nev.	Generators for units A3 and A4, Hoover power plant.
	Power transformers for units A3 and A4, Hoover power plant.
	Turbines and governors for units A3 and A4, Hoover power plant.
Central Valley, Calif.	Radial gates and hoists for Friant-Kern Canal.
	Grading and paving substation area and construction of railroad spur at Elverta substation.
	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal, near Porterville, Calif.
Colorado-Big Thompson, Colo.	Radial gates and hoists for Olympus Dam.
	Construction of about 50 miles of 69-kilovolt wood-pole transmission line from Brush to Yuma, Colo.
	Construction of 30 miles of 115-kilovolt wood-pole transmission line from Loveland to Greeley, Colo.
Columbia Basin, Wash.	Extension of 6,900 volt station service switchgear XLS, Grand Coulee left power plant.
	Unit substations, unit control boards, and miscellaneous distribution boards for Grand Coulee pumping plant.
	Elevators for Coulee Dam and power plant.
	Completion of Grand Coulee pumping plant, warehouse A and B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, water storage reservoir for Coulee Dam; assembly of caisson seat form and face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
	Construction of lining and structures for 6.6 miles of main canal from Long Lake Dam to bifurcation structure to West and East low canals, near Stratford, Wash.
	Construction of earthwork and structures for 15.3 miles of the West canal near Ephrata, Wash.
	Construction of 12,000 feet of concrete and steel siphon near Soap Lake, Wash.
	Construction of earthwork and structures for approximately 8.3 miles of Potholes East Canal near Norden, Wash.
Davis Dam, Ariz.	Power transformers, oil circuit breakers, and disconnecting switches for Phoenix substation.
	Construction of 80 miles of 115-kilovolt wood-pole transmission lines from Tucson to Cochise, Ariz.
	Trashracks for Davis Dam.
	Erection of river gaging station and cable way at Davis Dam.
	Erection of steel structures for approximately 260 miles of 230-kilovolt transmission lines from Davis Dam to Phoenix via Prescott.
	Erection of steel structures for 70 miles of 230-kilovolt transmission line from Davis Dam to Hoover Dam.
	Constructing and furnishing equipment for 10,000 kilovolt Cochise substation.
Deschutes, Oreg.	Completion of construction of Wickiup Dam and relocation of forest service road near Lapine, Oreg.
	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base, Jefferson County, Oreg.
Hungry Horse, Mont.	Power transformers for Hungry Horse power plant.
	One 250-ton powerhouse crane.
	Construction of telephone and fire-alarm systems at Hungry Horse Government camp, 6 miles east of Columbia Falls Mont.
	Erection of 40 x 200-foot steel quonset type garage and fire station; construction of 24-room dormitory building; construction of 36 x 128 temporary office building; construction of 12 5-room and 6 6-room residences; construction of 1 10-car garage; construction of a guard headquarters building for Hungry Horse Government camp, 8 miles east of Columbia Falls, Mont.
Kendrick, Wyo.	Erecting foundation and 115- and 57 kilovolt bus structures for Casper, Wyo., substation.
	Construction of about 50 miles of 115-kilovolt transmission line from Seminoe to Casper, Wyo.
Mirage Flats, Nebr.	Erection of office building, 3 prefabricated residences, warehouse, utility buildings, well pump house and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Wyo.	Construction of 17 miles of 69-kilovolt wood-pole transmission line from Garland to Lovell, Wyo.
	Construction of 40 miles of 115-kilovolts wood-pole transmission line from Lovell, Wyo., to Yellowtail, Mont.
	1 22,500-pound gantry crane for Kortes Dam.
	Elevators for Kortes Dam and power plant.
Missouri Basin, Colo.	Construction of Bonny earthfill dam, on the South Fork of the Republican River, west of Hale, Colo.
Missouri Basin, Nebr.	Construction of the Superior-Courtland Diversion dam, a concrete overflow gravity structure, on the Republican River near Guide Rock, Nebr.
Missouri Basin, Wyo.	Constructing and furnishing equipment for the Pine Bluffs, Wyo., 6,000-kilovolt-ampere substation.
Missouri Basin, Wyo.-Nebr.	Construction of 160 miles of 115-kilovolt transmission line from Casper, Wyo., to Gering, Nebr.
Missouri Basin, Nebr.	Constructing and furnishing equipment for the Alliance, Nebr., 10,000-kilovolt-ampere substation.
	Furnishing and erecting 30 residences and installing utilities at Trenton Government camp, Trenton, Nebr.
Missouri Basin, Wyo.	Furnishing and erecting 16 residences for Government camp at Mills, Wyo.
Missouri Basin, N. Dak.	Construction of Dickinson dam, an earthfill structure near Dickinson, N. Dak.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Paonia, Colo.	Construction of Spring Creek earthfill dam, on East Muddy Creek about 20 miles northeast of Paonia, Colo.
Provo River, Utah	Construction of about ¾ of a mile of 6 foot 6 inch diameter concrete lined tunnels approximately 10 miles northeast of Provo, Utah.
	Construction of steel pipeline and structures for Big Cottonwood section, near Provo, Utah.
Rio Grande, N. Mex.	Construction of 80 miles of 115-kilovolt wood-pole transmission line from Socorro to Albuerque, N. Mex.
Riverton, Wyo.	Painting dwellings and other buildings at Riverton Government camp, Wyo.
San Luis Valley, Colo.	Construction of Patoro earthfill dam, on the Conejos River about 30 miles northwest of Mogote, Colo.
Tucumcari, N. Mex.	Construction of earthwork and structures for Conchas Canal (Mile 59.4 to Mile 77.3) and Lateral Unit No. 6 southeast of Tucumcari, N. Mex.

W. C. Austin Project

Altus, Oklahoma

vt. 34, no. 6

JUNE
1948

Featuring:

School Days
at
Shoshone
by John D. Abrahamson

KANSAS
Pioneers in
Irrigation
by William C. Brady

Reclamation
in
JAPAN
by Lindsey A. Brown

THE Reclamation ERA

Letters to the Editor

Assistant Commissioner Nelson recently received the following letter from Evan W. Hall, agricultural agent of the Chicago, Milwaukee, St. Paul & Pacific Railroad, Spokane, Wash. The article to which he refers was "Silt—Despoiler of the Soil." We agree with Mr. Hall, and were proud to have the privilege of printing Mr. Nelson's article.

ROOM 15, UNION STATION,
SPOKANE 8, WASH., *April 3, 1948.*

DEAR MR. NELSON: Your article in the March issue of THE RECLAMATION ERA is of outstanding importance and you have set forth the situation in a fine, clear, and easily understandable way. I am glad you made this contribution of sound thinking about our big reservoirs. We have passed over the silting problem much too lightly in the past. I think the Garrison Dam in North Dakota is going to be a real problem. I was raised on the Missouri River near Garrison and have sensed trouble ever since they talked about this reservoir.

I liked your comment at Phoenix and wish I could have the opportunity to know you better.

Sincerely,

EVAN W HALL.

Still Disappointed?

STAR ROUTE, 33,
FREEHOLD, N. J.,
January 26, 1948.

DEAR EDITOR: I just received my first issue of RECLAMATION ERA, and am somewhat disappointed. What I was looking for was pictures and experiences of settlers already on their land. For instance, in the Yuma project, army barracks were given away by the Government free to each settler, who in turn had to move them to the land himself. Were the barracks jacked up and moved as a whole, or did they all have to be dismantled?

Your picture and explanation of spiles was very good. Actually a spile is a crude valve that always leaks somewhat. In areas where there is a severe water shortage, have previous settlers found these spiles inefficient in the conservation of water? Has anyone devised a more efficient valve?

Settlers on the Yuma project had their land all planted in alfalfa when they arrived. Did any of them leave it in alfalfa? If any settlers did cut the alfalfa, what average yield did they get per acre per year? How many cuttings did they make? How much did they sell it for? Did it cover their first year's costs and living expenses? Did they rent machinery to cut and bale it, or did they have their own, or each buy their own?

Some settlers may have run out of ready cash. Since Reclamation land is United States property until all homestead laws are complied with and the land patented, no mortgage can be gotten on this land. How have local banks cooperated in situations of this sort?

You undoubtedly have a fairly large list of subscribers by now. Perhaps you could select at random about a dozen names from each of the various projects and send them a list of my and other questions, request photographs, giving them a small cash award or a year's subscription free, for their trouble. Unless you have reporters to do such work

Respectfully,

LEONARD RICHMAN.

Sorry to read of Reader Richman's disappointment—but the ERA must cover various phases of the Bureau of Reclamation's program and cannot be exclusively devoted to settlement stories. His suggestion in the last paragraph delights our editorial hearts—the cash award of course is prohibited in a Government publication, but we have a standing offer of **a free subscription for 1 year to anyone who contributes an article accepted for publication.** We need and want material which answers such questions as posed by Mr. Richman. We do not have reporters to do the work. Contributors to the ERA write articles in addition to their regular duties or on their own time.

Replying to his questions, in their order:

ARMY BARRACKS—see RECLAMATION ERA April 1947 (*The Bureau Reclaims Its Own*), May 1947 (*Homes for Veterans*); June 1947 (*Reclamation and the Housing Shortage*); November 1947 (*Spotlight on the Pioneers*), and February 1948

(*Continued on next page*)

Reclamation ERA

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

HUNGRY? YES, BUT HUSKY AND HEALTHY. These youngsters of the Powell School's first grade dig into a well-balanced meal of meat, potatoes, vegetable, fruit, and milk which will give them the energy required to study and play hard as is the custom at Powell. The little blond fellow seems to have a monopoly on the coeds. This photo was taken by Charles A. Knell, Sr., Region VI.

June 1948

Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation

Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management*, G. S. Ellsworth; *Chief Counsel*, Clifford E. Fix; *Chief Information Officer*, Leonard W. Mosby; *Chief Personnel Officer*, Glenn D. Thompson; *Director, Programs and Finance*, Alfred R. Golze; *Director, Branch of Operation and Maintenance*, Goodrich W. Lineweaver; *Director, Branch of Power Utilization*, Harvey F. McPhail; *Director, Branch of Project Planning*, John W. Dixon; *Comptroller*, William F. Kubach; *Director of Supply*, S. W. Crosthwait

DENVER OFFICE OF THE CHIEF ENGINEER: United States Department of the Interior, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Walker R. Young, Chief Engineer and Director, Branch of Design and Construction

Chief, Legal Division (Office of the Chief Counsel), Robert B. Starke; *Chief, Hydrology Division (Branch of Project Planning)*, John R. Riter; *Chief, Power Field Division (Branch of Power Utilization)*, E. C. Schurch; *Chief, Denver Finance Division (Office of the Director of Programs and Finance)*, Archie M. Rankin; *Associate Director of Supply (Office of the Director of Supply)*, J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller)*, Wendell Bramwell, Chief, Personnel Field Office (Office of the Chief Personnel Officer) Everett K. Gould.

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, H. T. Nelson; *Regional Engineer (Branch of Design and Construction)*, Grant P. Gordon; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, W. H. Tuller; *Regional Power Manager (Branch of Power Utilization)*, Don S. Campbell; *Regional Planning Engineer (Branch of Project Planning)*, E. N. Torbert; *Regional Programs and Finance Officer (Programs and Finance Division)*, A. W. Empie; *Regional Information Officer (Information Division)*, H. C. Blonk; *Regional Land Officer (Land Acquisition)*, W. B. Wallace; *Regional Counsel (Legal Division)*, H. R. Stinson; *Regional Personnel Officer (Personnel Division)*, V. L. Rushfeldt; *Regional Supply Officer (Supply Division)*, James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Anderson Ranch Dam construction office	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Payette pump unit construction office	R. W. Adams	Construction engineer	Caldwell, Idaho.
Cascade Dam construction office	Earl Harmon	do	Cascade, Idaho.
Payette division O. & M. office	Theodore Nelson	Irrigation manager	Notus, Idaho.
Owyhee project O. & M. office	J. F. Spofford	do	Nyssa, Oreg.
Vale project O. & M. office	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes project	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hungry Horse project	C. H. Spencer	do	Columbia Falls, Mont.
Lewiston Orchards project	Wilfred L. Karrer	do	Weisberger Bldg., 5th and Main, Post Office Box 621, Lewiston, Idaho.
Minidoka project	S. R. Marean	Superintendent	301 North Hansen Ave., Burley, Idaho.
Palisades project	I. Donald Jerman	Project engineer	Post Office Box 1259, Idaho Falls, Idaho.
Yakima project	O. W. Lindgren	Superintendent	Federal Bldg., Yakima, Wash.
Planning Offices and Independent Field Stations			
Kalispell planning office	Charles S. Hazen	Planning engineer	13 East 2d St., Post Office Box 97, Kalispell, Mont.
Medford planning office	F. C. Hart	do	123½ W. Main St., Post Office Box 1389, Medford, Oreg.
Salem planning office	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla planning office	M. Boyd Austin	do	McCaw Gen. Hospital, Veterans' Adm. Reservation, Post Office Box 718, Walla Walla, Wash.
Rathdrum Prairie project, Post Falls unit, independent field station.	E. A. Lavonture	Watermaster	Route 2, Post Falls, Idaho.
Missoula Valley project, Big Flat unit, independent field station.	Pierre J. LaCasse	do	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Umatilla project, independent field station	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director*, R. S. Calland; *Assistant Regional Director*, Phil Dickinson; *Assistant to the Regional Director*, U. J. Gendron; *Regional Engineer (Branch of Design and Construction)*, A. R. McGinness; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, J. G. Lindley; *Regional Power Manager (Branch of Power Utilization)*, B. W. Crelm; *Regional Planning Engineer (Branch of Project Planning)*, S. A. Kerr; *Regional Finance Officer (Finance Division)*, J. F. Kastl; *Acting Chief (Land and Right of Way Division)*, Joe H. Leech; *Regional Information Officer (Information Division)*, Max Stern; *Regional Counsel (Legal Division)*, L. O. Graham; *Regional Personnel Officer (Personnel Division)*, H. F. Osborne; *Regional Supply Officer (Supply Division)*, H. F. Halliday

	Official in charge		Address
	Name	Title	
District Offices			
Delta district	C. H. Kadie, Jr.	District manager	Post Office Box 1407, Sacramento 10, Calif.
Klamath district	Raymond R. Best	do	Post Office Box 312, Klamath Falls, Oreg.
Lower San Joaquin district	J. W. Rodner	do	Post Office Box 1270, Merced, Calif.
	O. G. Boden	Construction engineer	Antioch, Calif.
	L. J. Lang	Engineer	Post Office Box 1372, 1115 Eye St., Modesto, Calif.
	G. C. Imrie	Resident engineer	Tracy, Calif.
Sacramento Valley district	James K. Carr	District manager	Post Office Box 302, Chico, Calif.
	William J. McCrystal	Construction engineer	Redding, Calif.
	C. L. Brown	Acting superintendent	Post Office Box 30, 114 Second St., Colusa, Calif.
	R. W. Hollis	Watermaster	Orland, Calif.
Tulare Basin district	Robert B. Cozens	District manager	406 Patterson Bldg., Fresno, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.
Project Planning Offices			
Santa Barbara	J. H. Fertig	Engineer	201 La Arcada Bldg., 1114 State St., Santa Barbara, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer (Branch of Design and Construction)*, C. A. Bissell; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, A. B. West; *Regional Power Manager (Branch of Power Utilization)*, R. V. Sprague; *Regional Planning Engineer, (Branch of Project Planning)*, E. G. Nielsen, *Regional Finance Officer (Finance Division)*, M. E. Rains; *Regional Counsel (Legal Division, Los Angeles, Calif.)*, R. J. Colley; *Regional Supply Officer (Supply Division)*, O. J. Littler; *Regional Personnel Officer (Personnel Division)*, M. H. Mitchell; *Regional Progress Control Officer (Progress Control Office)*, D. A. Dedel; *Chief, Office of River Control*, C. P. Vetter.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
Gila (Construction)	Murray J. Miller	Construction engineer	Yuma, Ariz.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
All American Canal (Coachella division)	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	Post Office Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	Project engineer	Parker Dam, Calif.
San Diego	R. E. Burnett	Engineer	Escondido, Calif.
Project Planning Offices and Design Units			
Escondido planning office	R. E. Burnett	do	Post Office Box 357, 414 West 3d St., Escondido, Calif.
Overton planning office	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix planning office	V. E. Larson	Assistant regional planning engineer	337 West Washington, Phoenix, Ariz.
St. George planning office	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.
Davis Dam design unit	H. I. Fitz	Head, design unit	Box 2071, Aviola Corp. Bldg., Phoenix, Ariz.
Davis transmission system design unit	A. J. Ecker	do	Do.
Coachella design unit	H. R. Voris	do	360 South San Gorgonio Ave., Banning, Calif.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant Regional Director*, C. D. Woods; *Regional Engineer (Branch of Design and Construction)*, C. H. Carter; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, D. S. Stuver. *Chief, Resources and Development (Branch of Power Utilization)*, L. E. Mathews; *Regional Planning Engineer (Branch of Project Planning)*, Reid Jerman; *Regional Finance Officer (Finance Division)*, F. J. Farrell; *Regional Counsel (Legal Division)*, J. S. McMaster; *Procurement Officer (Supply Division)*, E. G. Bywater.

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Paonia	R. W. Jennings	do	Post Office Box 623, Paonia, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area and Field Offices			
Fallon	W. H. Slattery	Engineer	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Hedderman	Area engineer	Masonic Bldg., Post Office Box 640, Durango, Colo
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 780, Grand Junction, Colo.
Kemmerer	P. B. Delong	Engineer	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	Area engineer	46 East Center, Post Office 294, Logan, Utah.
Salt Lake City	R. C. Johnson	do	211 Federal Bldg., Post Office Box 360, Salt Lake City 8, Utah.
Spanish Fork	P. R. Neeley	do	Post Office Box 71, City Hall, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Texas

Regional Director, H. E. Robbins, *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Special Assistant to the Regional Director*, E. T. Giles; *Regional Engineer (Branch of Design and Construction)*, O. L. Craft, *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, R. S. Bristol; *Regional Power Manager (Branch of Power Utilization)*, A. H. Sullivan, *Regional Planning Engineer (Branch of Project Planning)*, Rex R. Reed, *Assistant Regional Programs and Finance Officer (Programs and Finance Division)*, C. L. Harris, *Regional Counsel (Legal Division)*, S. L. Baird, *Regional Personnel Officer (Personnel Division)*, H. F. Kirby; *Regional Supply Officer (Supply Division)*, I. G. Campbell, *Regional Safety Advisor*, G. F. Peterson.

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	J. A. Callan	Project engineer	Altus, Okla.
Balmorhea	J. A. Maxcety	Engineer in charge	Balmorhea, Tex.
Carlsbad	H. H. Kibbler	Project superintendent	Carlsbad, N. Mex.
Rio Grande	L. R. Flock	do	U. S. Courthouse, El Paso, Tex.
Elephant Butte Power & Storage	Labon Barker	Acting division superintendent	Elephant Butte, N. Mex
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta	F. D. Postle	do	Ysleta, Tex.
San Luis Valley	W. H. Sweet	Acting project engineer	117 Jefferson St., Monte Vista, Colo.
Tucumcari	R. J. Lyman	Project superintendent	Tucumcari, N. Mex.
Valley Gravity	John C. Thompson	Project engineer	McAllen, Tex.
Project Planning Offices			
Albuquerque	J. L. Mutz	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	H. P. Burleigh	do	Littlefield Bldg., Austin, Tex.
Oklahoma City	M. O. Barclay	do	Post Office Box 495, 516 Oklahoma National Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Yale Building, Post Office Box 2130, Billings, Montana

Regional Director, Kenneth F. Vernon; *Assistant Regional Director*, W. E. Rawlings; *Assistant to the Regional Director*, George O. Pratt; *Regional Engineer (Branch of Design and Construction)*, C. G. Anderson; *Acting Regional Supervisor (Branch of Operation and Maintenance)*, E. F. Landerholm; *Regional Power Manager (Branch of Power Utilization)*, J. R. Walker; *Acting Regional Planning Engineer (Branch of Project Planning)*, C. T. Judah; *Regional Programs and Finance Officer (Programs and Finance Division)*, Duncan Mills; *Regional Land Officer (Land Acquisition Division)*, W. N. McCormick; *Regional Counsel (Legal Division)*, W. J. Burke; *Chairman, Interior Missouri Basin Field Committee*, W. G. Sloan; *Chief, Reports Coordination Division*, Edwin E. Wilson; *Regional Personnel Officer (Personnel Division)*, A. W. Gaede; *Regional Supply Officer (Supply Division)*, Fred W. Gilbert; *Safety Engineer (Safety Division)*, Charles C. Parsons; *Chief, Municipal Water Supply Investigations Unit*, Stanton J. Ware.

	Official in charge		Address
	Name	Title	
District and project offices			
Yellowstone district	Donald C. Ketcham	District manager	Box 1264, Billings, Mont.
Fort Peck	Allen Mattison	Resident engineer	Box 1245, Fort Peck, Mont.
Yellowstone pumping unit	R. B. Kuebler	Engineer	Box 720, Miles City, Mont.
Hardin unit	R. F. Herdman	Construction engineer	Box 516, Hardin, Mont.
Buffalo Rapids	A. H. Whitmore	Acting construction engineer	Terry, Mont.
Moorhead Dam	R. F. Herdman	Construction engineer	Gillette, Wyo.
Upper Missouri District	Harold E. Aldrich	Acting district manager	Box 1629, Great Falls, Mont.
Milk River	H. W. Genger	Superintendent	Malta, Mont.
Canyon Ferry	William P. Price, Jr.	Construction engineer	Box 517, Helena, Mont.
Sun River	C. L. Bailey	Superintendent	Fairfield, Mont.
Big Horn district	R. H. Workinger	District manager	Box 839, Cody, Wyo.
Shoshone-Heart Mountain	W. F. Kemp	Acting project engineer	Box 900, Cody, Wyo.
Boysen and Owl Creek	R. S. Lieurance	Project engineer	Box 1111, Thermopolis, Wyo.
Riverton	T. A. Clark	Acting project engineer	Riverton, Wyo.
Missouri Souris district	Bruce Johnson	Acting district manager	Box 1050, Bismarck, N. Dak.
Missouri Souris	G. J. Chency	Engineer	Box 1869, Minot, N. Dak.
Cannonball Dam	Floyd Jensen	Construction engineer	Elgin, N. Dak.
Dickinson Dam	W. W. Brenner	do	Glen Ullin, N. Dak.
Heart Butte Dam	do	do	Do.
Missouri Oahe District	Joseph W. Grimes	Acting district manager	Box 825, Huron, S. Dak.
Angostura and Rapid Valley	H. V. Hubbell	Project engineer	Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Newell, S. Dak.
Bixby Dam	H. M. Crowell	Construction engineer	Faith, S. Dak.
Keyhole Dam	F. W. Goehring	do	Moorcroft, Wyo.
Shadehill Dam	D. M. Forester	do	Lemmon, S. Dak.

REGION VII: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director*, W. E. Blomgren; *Regional Engineer (Branch of Design and Construction)*, Herbert E. Prater; *O. & M. Supervisor (Branch of Operation and Maintenance)*, John N. Spencer; *Power Manager (Branch of Power Utilization)*, Harold R. Lee; *Planning Engineer (Branch of Project Planning)*, John A. Keimig; *Regional Finance Officer (Programs and Finance Division)*, Kenneth L. Smith; *Land Officer (Land Acquisition Division)*, Mark W. Radcliffe; *Regional Counsel (Legal Division)*, Clarence Eynon; *Personnel Officer (Personnel Division)*, Albert R. Novak; *Supply Officer (Supply Division)*, William F. Sha; *Administrative Officer, (Administrative Division)*, H. S. Varner, Jr.; *Safety Engineer (Safety Division)*, Alton T. Cromwell.

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Casper (North Platte Basin)	do	do	Do.
Glendo	Murel M. Starr	Construction engineer	Glendo, Wyo.
Guernsey (power)	John T. Hicks	Engineer	Guernsey, Wyo.
Guernsey (irrigation)	Nels P. Nelson	District irrigation superintendent	Do.
Kortes	C. S. Rippon	Construction engineer	Casper, Wyo.
Seminoe Dam	E. T. Walters	General foreman	Seminoe Dam, Wyo.
South Platte River district	E. S. Huntington	District manager	Building 11, Denver Federal Center.
Colorado-Big Thompson	Vacancy	do	Estes Park, Colo.
Fort Morgan	G. W. Hall	General foreman	Fort Morgan, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Green Mountain Dam	Lyle E. McIntosh	Power manager	Green Mountain Dam, Colo.
Horsetooth Reservoir	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	C. E. Klingensmith	do	Loveland, Colo.
Blue-South Platte project	J. H. Knights	District engineer	Building 11, Denver Federal Center.
Narrows Dam	Charles Seger	Construction engineer	Fort Morgan, Colo.
Kansas River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Bostwick Unit	Paul E. Strouse	Construction engineer	Superior, Nebr.
Enders Dam	U. V. Engstrom	do	Imperial, Nebr.
Medicine Creek	Clifford L. Mutch	do	McCook, Nebr.
Cambridge Diversion Dam and Cambridge Canal.	C. M. Jackson	do	Do.
Cedar Bluff	R. J. Walters	do	Ellis, Kans.
Culbertson Dam	Ellis L. Armstrong	do	Trenton, Nebr.
Bonny Dam	Wayne S. Byrne	do	St. Francis, Kans.
Ainsworth (Niobrara Basin)	C. E. Burdick	Area engineer	Ainsworth, Nebr.
Grand Island (Platte River investigations)	P. L. Harley	do	Grand Island, Nebr.
Pueblo (Gunnison-Arkansas and Upper Arkansas River Basin).	B. F. Powell	do	Box 515, Pueblo, Colo.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont.	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	W. J. Farrell	Boise, Idaho.
Boise (Payette division, Notus unit)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg.	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg.	O. E. Anderson	Superintendent.	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	do	Ralph L. Scheffer	Huson, Mont
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo.	A. P. Starr	President	R. B. Gregory	Austin Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo.	Carl Hicks	do	C. J. McCormick	Grand Junction, Colo.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo.	J. J. Flanagan	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	do	W. A. Long	do	Elmer Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev.	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont.	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	J. D. Large	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg.	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Districts 1 and 2	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont.	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont.	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield.	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	Superintendent.	Louie Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev.	Phillip Hilbel	do	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	S. F. Griffin	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr.	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr.	T. P. Winchell	Superintendent	Charles G. Klingman	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo.	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo
North Platte (Northport division)	Northport irrigation district	Northport, Nebr.	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	William T. Davis	Brigham City, Utah
Okanogan	Okanogan irrigation district	Okanogan, Wash.	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash
Pine River	Pine River irrigation district	Bayfield, Colo.	Roland Campbell	President	James F Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz.	O. L. Norman	Manager	J. F. Griswold	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgenson.	President	Joseph H Thompson	Ephraim, Utah
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Rudolph Hope	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo.	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo.	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg.	Leo Clark	Superintendent.	Mabel M. Richards.	Stanfield, Oreg
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert F. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont.	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev.	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg.	Roy W McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg.	A C Houghton	do	A. C. Houghton	Irrigon, Oreg
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo.	Jesse R Thompson	do	H. D. Galloway	Montrose, Colo
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D D Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg.	Ed Nunn	do	P. B. Smith	Hermiston, Oreg
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	O. L. Sterling	do	O. L. Sterling	Ellensburg, Wash
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	David C. Brooks	do	Pauline Osterhout	Sunnyside, Wash
Yakima (Tieton division)	Yakima-Tieton irrigation district	Yakima, Wash.	Guy Finley	Manager	Guy Finley	Yakima, Wash.

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(*Golden Harvest at Klamath*). In general, it was considered best to move the barracks as a whole if they were to be used as units (house, barn, etc.) but to dismantle them if the material was to be used in building structures which could not utilize the basic construction of the barracks.

SPILES—Settlers have sometimes found spiles inefficient—although they are still in wide use. The plastic siphon is gaining in popularity although it is comparatively new and it is too soon to draw comparisons.

YUMA PROJECT SETTLERS—Mr. Richman is probably referring to the public lands in the Yuma Mesa Division of the Gila project in Arizona. This area has not been settled yet. The closing date for simultaneous filing for one of these farms was March 30, 1948. However, the Government planted alfalfa on these public lands prior to their being made available for settlers and we do have some statistics as a result.

The crop averaged 5 tons to an acre and was cut between five and seven times during the year. At the last Government sale, alfalfa brought $22 per ton. Custom machinery is available for baling of alfalfa by settlers in this area.

LOANS—Loans on public lands for which patents have not been obtained, can be secured through the facilities of the Farmers Home Administration and local banks. The farmer pledges his chattels and crops as security. See "*Golden Harvest at Klamath*" for an example of the fine cooperation local banks have shown to reclamation settlers.—Ed.

Rooting for Root Systems

COOPERATIVE EXTENSION WORK IN
AGRICULTURE AND HOME ECONOMICS,
STATE OF UTAH—LOGAN
February 25, 1948.

DEAR EDITOR: I was very much interested in Mr. L. R. Fiock's article, "How to Conserve Irrigation Water" and agree with practically every thing he says except the statement on page 26 of the February issue, "Plants should be forced to develop a deep root system during the early part of the growing season."

For 25 years I have thought we could do this very thing by keeping the moisture content very near the wilting point and because the moisture was low it was my opinion the roots would push down to seek moisture.

According to data recently secured by the Bureau of Plant Industry here at this College, this is an erroneous assumption. They found where sugar beets were allowed to become dry early in the season that no matter what the water treatment later, the result was a decreased yield. These results, however, were obtained in a climate with limited growing season and may not apply where the growing season was sufficiently long.

In other words, the interpretation I put on the results is that the only way to "force" plants to develop a good root system is to keep "optimum" water content in the soil neither too dry or too wet. I know from past experience that almost the universal idea among Utah farmers (and I shared the same idea until recently) has been to force plants to develop a good root system by starving them for water while young and thereby making the roots go deeper for water. Possibly Mr. Fiock only intended to emphasize the fact that young plants should not be over irrigated, to which I subscribe wholly, but let us not mislead people into believing that we can make plants grow without giving them the proper amount of moisture.

Very truly yours,

JAMES R. BARKER,
Extension Irrigation Specialist.

Reader Barker is absolutely right. Mr. Fiock *was* emphasizing the fact that young plants should not be over irrigated—but did not intend to imply that they should be made to suffer through water starvation. No plant will develop a root system in dry soil, and if moisture is available in the deep subsoil, crops will develop a normal root system, in which endeavor they should be encouraged—but not at the risk of stunting their growth through underwatering. To quote Mr. Barker, "the *proper* amount of moisture" is the answer.—Ed.

Reclamation Place names in this Issue

(Date)

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Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

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School Days at Shoshone

by JOHN D. ABRAHAMSON, Economist
Branch of Project Planning
Region VI, Billings, Mont.

A visitor to the Shoshone project in Wyoming soon hears from some enthusiastic resident (and they all seem to be enthusiastic) that the Shoshone project is the garden spot of Wyoming. Before the visitor has an opportunity to wedge in a word the resident is sure to follow up with, "and we have the best school system in Wyoming, too."

You do not need to remain long to be impressed, particularly by the school system. Any school day between 8 and 9 in the morning and at 4 o'clock in the afternoon a seemingly endless line of busses pass by—loaded to the doors with children headed to and from the Powell consolidated school.

The Powell school is located in the town of Powell in the heart of the Shoshone project, Wyoming. The school provides courses from the primary grades through junior college, with a system organized on a 6–2–4–2 plan. This means that there are six grades in the elementary school, 2 years in junior high school, 4 years in high school, and 2 years at the college level.

The college is a part of the University of Wyoming even though it is housed in the high school and uses the school's laboratories, library, commercial department, and shops. It is referred to as the University of Wyoming, northwest center. The arrangement with the university provides many benefits. Courses at the university center are similar in content and have the same standards as those given at a well established university. Course credits have the same college entrance value as at the university—being similarly accredited.

The Powell school plant consists of three brick buildings. The oldest building (which at one time housed the entire school) has been refinished and now contains the first four grades of the elementary school. The other two buildings are of recent construction and have incorporated in them the latest in school design. One of the two is occupied by the remaining portion of the elementary school and the junior high school. The main building houses the high school and college. A new bond issue recently voted will provide $520,000 for additional buildings.

The enrollment for the entire system now totals 1,625. There are 60 teachers with an average load of 27 pupils each. As you can see, the number of pupils per teacher is carefully

LEFT, Dolores Pect and Dick Honeysett in the chemistry laboratory. BELOW, Instructor Robert J. Bishopp gives a group of juniors some tips on acetylene welding. L. to R.: Bishopp, Duane Edwards, Joe Kawano, Thayer Cox, and Lloyd Myers. Photos by Charles A. Knell, Sr., Region VI

STREAMLINED—even to the 18 busses which make 1,500-mile trip daily. Photo by T. R. Broderick, Region VI, Artwork by Shirley A. Briggs.

controlled to avoid excessive load. However, if circumstances do not permit an adjustment to a lighter load of a standard number of pupils, the teacher's salary schedule provides for additional compensation. Teachers' salaries range from $2,000 to $3,800, with 5 days' sick leave allowed each year. The sick leave is cumulative up to 15 days if unused. Attractive to the married teachers is an annual family allowance which is granted by the board of trustees. For superior merit the board awards special salary increase to any teacher.

The results of such a salary schedule, with sick leave provisions, family allowances and awards for merit is obvious in the enthusiasm and loyalty that the teachers have for their school. An esprit de corps not often observed exists in the faculty.

Superintendent of Schools C. W. Richard and Director C. C. Moore of the northwest center explain that the function of the school is to prepare young people for life and the curriculum of the school is organized accordingly. The pupil has the opportunity of selecting a college preparatory curriculum or one which will introduce him to a vocation.

Beginning with high school, young people can acquire substantial training in a broad assortment of fields which they can carry through college.

A high school pupil selecting an agriculture course receives practical training in all phases of agriculture. He spends a required period of study in a modern well-equipped shop. There he learns how to handle blacksmith tools and forge, how to weld with acetylene, and electric arc, and how to repair farm machinery by actually performing the job.

In the classroom he studies livestock and crops and learns the practical application of his knowledge through the Future Farmers Club of the school. The club conducts a cooperative farming program whereby the members cultivate a 20-acre irrigated plot near the school. In the 1945–46 school year the plot was seeded to field beans. In the same year the club purchased and fattened a carload of lambs.

Powell's modern high school curriculum encourages Barbara Van Buskirk (left) and Doris Booze to ready themselves for the business world.

Third graders Wesley Wilson and Ronald Rickard enjoy lunch. No coaxing needed here. Both photos by Charles A. Knell, Sr., Region VI.

Top photo. Adult students learn building in night classes. *Center.* Principal Henry Rebbe makes announcement over public address system to students in all class rooms while Superintendent of Schools C. W. Richard looks on. *Bottom.* Jean Sand, left, and Claudia House, learning the fundamentals of Home Economics. (Top photo by T. R. Broderick, other two by Charles A. Knell, Sr., Region VI.)

The income from the work-study program is used to buy farm equipment and to finance club activities, and the club now owns farm equipment valued at $4,000. Through the club, the school is represented by judging teams in every State and local agricultural contest and it also sponsors annual judging contest of its own. The National Association of Future Farmers rates the club as one of the 21 best in the United States.

The pupil's agriculture study, although already very thorough, does not discontinue there. The school plant includes a slaughter room. There the agriculture pupil delivers his live hog, beef, or lamb and under instruction performs each step to the final chop, steak, or roast and renders lard in a 40-gallon steam-heated vat.

When his vegetable and fruit crop is mature in the late summer, he delivers it to the school. Under faculty direction he prepares his produce and places it into 1 of 12 blanching vats. After canning, the tins are placed in a rack, transported by an overhead crane to one of six retorts where they are cooked. Three of the retorts have a capacity of 118 cans and three a capacity of 88 cans.

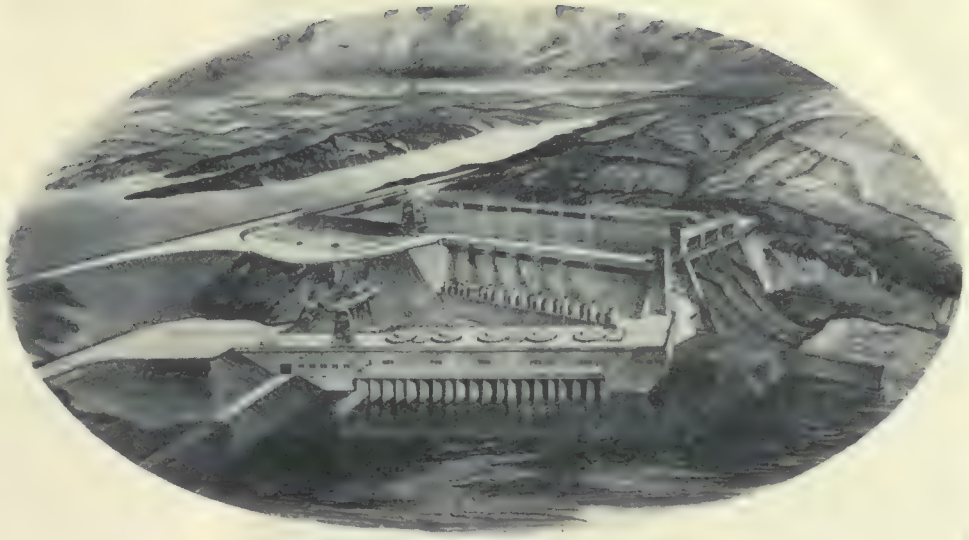
Although a pupil receives thorough training within a selected curriculum the broader aspects of education which fit him for life in a democracy are not overlooked. His background after high school includes study in the physical science, biological sciences, social science, and the humanities.

A well-balanced program is offered in each of these fields of knowledge. In the field of humanities the school maintains an enviable record. Over the years a music library has been established and a collection of musical instruments has been made for band and orchestral use. The music library now consists of 250 overtures and selections, 300 marches, 15 standard symphonies and a miscellany of ensemble music. Two bands, one of 90 pieces and the other of 80 pieces are maintained. The 90-piece band is composed of beginners who are transferred to the 80-piece band as they become accomplished. A girl's chorus of 102 voices and a boy's chorus of 40 voices represent those who have attained accomplishment in voice.

The community influence of the school is widespread. It reaches so often into so many homes that it is an integral part of life. College courses running until 10 o'clock in the evening permit adults to continue their education or to take selected courses. Adult classes in music are conducted. This year adult classes in shop will be resumed. Courses offered will consist of a course in farm machinery repair, general carpentry, cabinet making, and millwork. The canning center was utilized by 125 families last fall. It is anticipated that in the next canning season more than twice that number will use the facilities.

Mass transportation is the keystone of the Powell school system. Without it the school would be just another rural school. Of the 1,625 pupils in attendance 45 percent are transported from country homes distributed over an area of about 350 square miles. Eighteen busses are required. They cover a route estimated to be 1,424 miles long. Each bus is operated by a part-time driver who may otherwise be a mechanic, a farmer, or a clerk. The busses begin their runs at 7:30 in the morning and arrive at the school between

(Continued on page 166)



Reclamation Engineer J. MacGilchrist, of Denver, Colo., has drawn this conception of how Davis Dam will look when completed. The dam embankment at left spans the Colorado River 67 miles below Hoover Dam. The power plant is at the bottom left, and the diversion, spillway, and forebay channel and the spillway are in the center and right foreground.

DETOUR at DAVIS*

by H. F. BAHMEIER

Construction Engineer, Davis Dam Project, Region III

They are throwing the switch next month at the Davis damsite to sidetrack the Colorado River.

For the fourth time in history industrious man is moving the Colorado out of its age-old bed and running it around a site on which he is building a dam. To do this he has dug a huge 4,500-foot ditch called a diversion, forebay, and spillway channel. It is a case of detouring the river for all time as the channel is a permanent feature of the Davis Dam project.

The Colorado's new route leaves the river just below Bullshead Rock (for which the project originally was named) makes a quarter-moon arc around the Arizona abutment of the dam, and reenters the old river channel some 500 feet below the downstream end of the power plant. Part of the channel is excavated in solid rock to a depth of 200 feet.

Man accomplished a similar feat at Hoover and Parker Dams with huge tunnels driven through the canyon walls, and at Headgate Rock Dam, an Indian Service project, through an open channel where the river leaves the canyon confines. At other dams on the lower Colorado—Laguna and Imperial—the river was alternately juggled to flow over some sections of the structures while work was being carried along on others.

The switch which will put the river on the new main line at Davis Dam will be a cofferdam constructed simultaneously with the removal of two temporary earth plugs in the diversion channel. The switchman will be the main contractor, the Utah Construction Co., supervised by engineers of the Bureau of Reclamation.

Those who envision a torrential rush of water through the diversion channel will be disappointed. While the operation will be worth observing, the action will be gradual and unspectacular, extending over a period of several days. Significance of the event lies not in the physical act of diverting the waters but rather in the knowledge that man again will have proved himself to be master of the mighty river. He is accomplishing one more step in his program of harnessing the Colorado and making more secure his existence in the southwest desert.

Here's how the diversion will take place: First, the contractor will remove the earth plugs in the diversion channel with draglines. As the huge machines chew away the plugs opposing entrance of the river, the water will "trickle" into the entrance of the channel. Upstream at the Hoover powerplant the water releases through the turbines will be slowed down to reduce the flow at the Davis damsite to the minimum necessary for irrigation and power requirements. Thus Hoover Dam, the first conqueror of the river, plays a major part in effecting each successive control.

Simultaneously with the removal of the plugs, huge Euclid trucks will shuttle across the trestle which occupies the site of, and will be buried by, the upstream cofferdam. The trucks will first drop huge rocks into the river between the trestle bents. Then smaller material will be dropped until the bridge is embedded and the barrier sealed. The entire flow of the river will then be forced through the channel.

Construction will be started immediately after the initial diversion on another cofferdam below the damsite and just above the point where the channel delivers the river back to

(Continued on page 108)

*See "How to Sidetrack a River," in June 1946 issue of the ERA.

RECLAMATION in *JAPAN*

by LINDSEY A. BROWN

Land Reclamation Specialist, Natural Resources Section, Supreme Commander for the Allied Powers

Published with the permission of the Chief, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers.

Aerial view of stream valley built up with paddies surrounded by unirrigated crop land. The small round areas are irrigation water storage ponds. Scale about 2500: 1. Near Tokyo. ←

JAPAN waged an aggressive war and one of her objectives was to obtain more food.

For many decades agricultural authorities throughout the world had assumed that Japan had more completely developed her food-producing resources than any other major country.

Yet within her own borders, there were untouched potentialities for increasing the food supply as much as 30 percent.

These are the facts, which surprised United States occupation forces in 1945 when defeated Japan found herself far short of sufficient crop production to feed her expanding millions. For the population of Japan is a little more than 78,000,000, and is increasing at the rate of over 1,000,000 per year.

Under the guidance of American technicians, an extensive land-development program has been initiated. While the successful completion of this program will not solve the food problem completely, it will furnish partial relief for one or two decades, to give Japan time to adapt her economy to new conditions. Even with intensive efforts to produce more food, if the present rapidly expanding population trend continues, Japan will remain dependent on foreign trade for over 20 percent of her food supply.

The program, which carries the highest priority for funds and materials, includes plans to increase the food supply as much as 30 percent by land reclamation and improvement. Irrigation development, land improvement, and conservation are coordinated into a single land development program. Irrigation and drainage facilities will be improved on over 5,000,000 acres, 700,000 new irrigated acres will be developed, and over 3,000,000 acres of forest and grassland will be brought into cultivation without irrigation. About 17 percent of the program has been accomplished in the past 2 years.

Sixteen percent of Japan's area is under cultivation and approximately 5 percent more is susceptible of cultivation in the future. Over half of the cultivated land in Japan is under irrigation and is used for the production of rice. Most of the water for irrigation is obtained by direct diversion from streams. Reservoirs, wells, and springs furnish irrigation water locally. The supply varies from excessive to inadequate depending on precipitation and the nature of the water source. Japan's mean annual precipitation is 40 to 100 inches. High mountains with short distances traversed by streams in reaching sea level has given rise to torrential streams and severe flood hazards to valley farm lands during periods of heavy precipitation.

Reclamation in Japan differs from that in the United States in several basic features. First, the need for additional food is extremely intense, so the highest priority for funds and materials is granted for projects designed to increase food production. Second, it includes the preparation of land for cultivation without irrigation, the improvement of drainage and irrigation facilities for irrigated rice land, the construction of irrigation facilities for production of rice, and the protection of agricultural land from flood hazards. And third, all irrigation development is for the purpose of producing paddy rice, since normal precipitation is adequate for production of other crops.

The improvement of irrigation and drainage facilities on 5,000,000 acres of paddy land in Japan will increase the food production potential by about 15 percent. In terms of increased food production per unit of critical materials used in construction, these improvement projects are among the most economical planned. They include diversion works, canal construction, and improvement projects similar to many in the United States.

Water warming projects, although unique, are common in the northern part of Japan. The water is warmed for use

on paddies by holding it in shallow basins exposed to the sun until its temperature has been raised several degrees. Some small reservoirs suffice for water warming, but in other projects the water is conducted slowly through a maze of broad shallow channels before being released on the paddies.

Over 200,000 acres of shallow water areas near river deltas are scheduled for conversion to farm land. The land is above low tide and below high tide. The method of reclaiming such land has been in use in Japan for many decades. A sea wall is constructed high enough to hold back the highest tides and waves. Drainage canals are then constructed to empty at gates in the sea wall. The gates are hinged at the top in a manner which allows them to open at low tide and close at high tide. Within 1 years after good drainage is established, soluble salt concentrations can be reduced below the toxic level by leaching, due to the high precipitation.

The cost per unit area is high for reclaiming shallow water land from the sea. But it results in adding to the most fertile farm land in Japan. The soils are exceptionally high in nutrients, and fertilization does not become a problem until 5 to 10 years after farming is started. This is in sharp contrast to newly reclaimed upland soils. These must be improved by adding large quantities of fertilizers and lime before satisfactory crop yields can be produced.

The Japanese National Government and local agencies wage an endless battle to control all streams at high stages. Levees, pumping plants, and by-pass channels in the lower reaches of the larger rivers are the chief flood control weapons. Check dams and flood control dams along the upper stream courses furnish important controls. Forest and soil conservation methods also lend major support to control measures on the upper watersheds.

The methods used in drainage, flood protection, and irrigation in delta areas of the larger rivers produce high returns in increased crop production potential at a low maintenance cost. The Ogura-ike project near Kyoto illustrates this type of project.

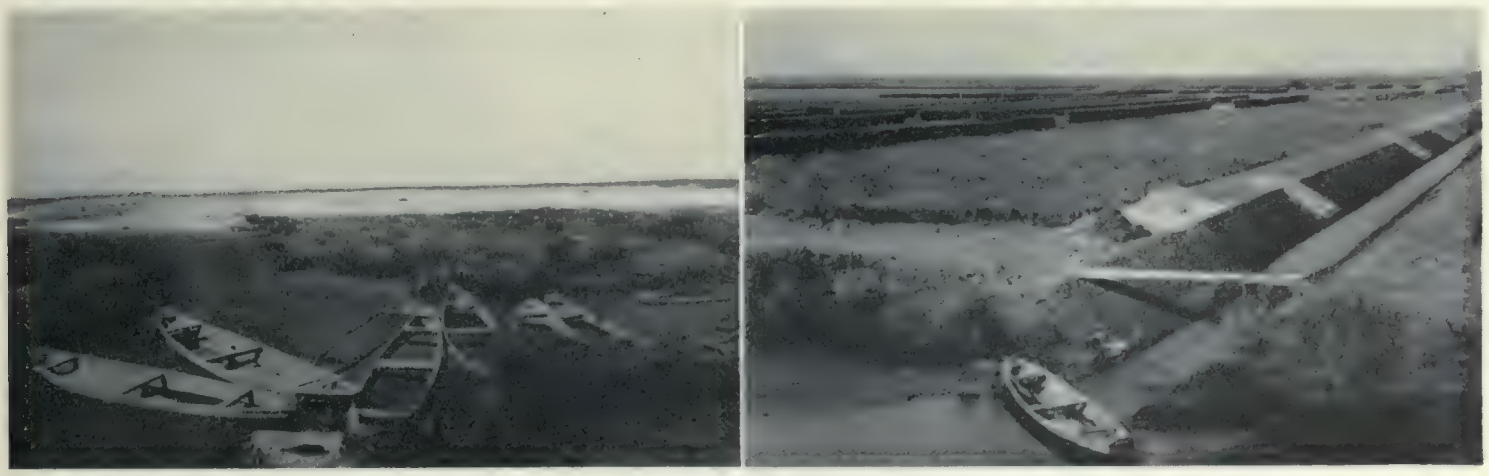
In this area 1,500 acres were under water a large portion of each year and 10,000 acres of cropped land had poor drainage or were damaged frequently by floods. A pumping plant, consisting of 12 electric-powered pumps capable of discharging 1,140 cubic feet per second, was constructed on the Lodo

Foreground, hand-smoothing of paddy before transplanting rice; background shows horses serving same purpose.

River levee. Three systems of drainage canals, each at a different discharge level, were constructed to the pumping station. Irrigation is provided by still another canal system. The low-level system goes directly to the pumping sump and the canal contents are pumped into the river at all times. The middle level canal discharges water from higher lands into the river by gravity while the river is at low stages, but is pumped in at high and flood stages. The high level system drains the highest land and discharges into the river by gravity at all times except during flood stages when it is pumped. Drainage or river water is conducted into the irrigation canal system as river stage and water needs dictate.

The system provides for heavy use of hydroelectric power at peak production stages and a low demand on firm power.

Japan's experience, proving that she could increase her food production considerably through land development—at a fraction of the cost of war—indicates the intense need for the world as a whole to reexamine and utilize its land resources. Land development in most countries can aid greatly in alleviating food shortages and thus taking another step along the road to peace. END



LEFT: Ogura-ike project before drainage. RIGHT: Same development after drainage (note rice on field-curing racks in background).

School Days at Shoshone

(Continued from page 164)

8:30 and 9 a. m. At 4 p. m. the busses concentrate at the school, and, as they are loaded, pull out one by one to deliver each child to his home.

The Powell school stands as a tribute to reclamation and to the men and women who had the fortitude and endeavor to pioneer the Shoshone Reclamation project. Back in 1904 the area which made possible and now sustains this educational institution was an area of cactus and sagebrush flats capable of providing a living for little more than prairie dogs and rattlesnakes. The people have ample reason for being so enthusiastically proud of their project and the merits of Powell School, district No. 1—an institution of learning.

END

Detour at Davis

(Continued from page 165)

its present bed. After completion of the upstream and downstream cofferdams the construction area in the old river bed will be unwatered, and excavation for the dam foundation will begin.

Davis Dam is being constructed by the Bureau of Reclamation as another step in the development of the Colorado River, taking its place along with Hoover, Parker, Headgate Rock, Imperial, and Laguna Dams in conserving and utilizing the potential resources of the stream. The project's name was changed from Bullshead Dam to Davis Dam in 1942 in honor of Arthur Powell Davis. As director of the Reclamation Service from 1914 to 1923, Davis helped lay the foundation of the planned development of the river. The project serves the following purposes:

- fulfillment of Mexican Treaty provisions for the division of the waters of the Colorado and Tijuana Rivers and the Rio Grande;
- production of hydroelectric power which is urgently needed in the power-short southwest; and
- reregulation of the irregular water releases from the Hoover power plant for the benefit of irrigated areas downstream. In addition the reservoir created by the dam will provide recreational advantages such as fishing, boating, and swimming.

Under construction since April 1946, Davis Dam is scheduled to be substantially completed within the next 2 years. Progress to date includes excavation of over 3,000,000 cubic yards of rock and earth to form the diversion, forebay, and spillway channel; grouting of the foundations for the intake, spillway, power plant, and other structures; and placing of concrete in the forebay section of the channel and in the intake and spillway structures.

Placing of the concrete has been carried out to a height sufficient to permit the diversion. Initially, the diversion will be through six openings that have been left in the spillway structure. Later the openings will be filled with concrete and the diversion will be through two outlet gates on either side of the spillway. Completion of the spillway crest, the intake and power-plant structures will be effected while the dam embankment is being placed across the old river bed.

Davis Dam will be an earth- and rock-filled embankment, rising 138 feet above the normal river bed. It will create a 4-mile-wide reservoir of 1,820,000 acre-feet, extending to the Hoover Dam power plant tailrace. The embankment will have a crest length of 1,600 feet and a crest width of 50 feet, across which a two-lane east-west highway will run. Almost 4,000,000 cubic yards of earth and rock fill will be required to form the dam and about 565,000 cubic yards of concrete and 20,000,000 pounds of steel reinforcing bars will go into the forebay, spillway, and power-plant structures.

The Davis power plant, with five 45,000 kilowatt semi-outdoor-type generators, will have an installed capacity of 225,000 kilowatts and an annual output of about a billion kilowatt-hours. Through interconnections with the Hoover and Parker power plants, Davis power will supply pumping plants on the Gila project in southwestern Arizona and power users in central and southern Arizona, southern Nevada, and southern California.

The author is construction engineer on the Davis Dam project for the Bureau of Reclamation and is assisted by Field Engineer J. R. Walton and Office Engineer H. R. Orr. H. E. Williams is project manager and T. L. Terry is general superintendent of the Utah Construction Co.

END

Sun River Crops Reach New High

Crops produced during 1947 on the Sun River project near Great Falls, Mont., largest operating project in Region VI, were valued at $3,086,692.56. This marked an increase of more than a half million dollars over the 1946 figure, a record year up to that time.

The net area under cultivation during 1947 was 81,788 acres, making an average per acre return of $37.74. The gross crop return includes $73,829.26 in Federal and factory payments for last year's sugar beet production and for soil conservation practices carried on during 1946.

Wheat led all other crops produced on the project in gross returns, with the 18,947 acres planted bringing a gross return of $1,106,644.92 or $58.41 an acre. The flaxseed crop was second with a total value of $526,521.40. Flaxseed was produced on 8,155 acres and brought an average return of $64.56. The third top money crop was alfalfa hay—valued at $452,380 and produced on 13,642 acres, an average return of $33.16.

The leading crop in per-acre return was white potatoes, with 312 acres bringing 52,476 or $168.14 an acre. Sugar beets, valued at $95.92 an acre including the beet tops, were second high in average return. The sugar-beet crop, planted on 925 acres, was valued at $88,726.75. Twenty-eight acres of the beet crop were a total loss because of a late spring freeze. Flaxseed was third high in average return.

The 31,631 acres of Sun River project lands planted in cereal grains produced crops valued at $1,619,805.76 or an average return of $51.21 an acre. Seed crops, including the previously mentioned flaxseed, were valued at $690,004.12, an average of $56.92 from the 12,123 acres planted.

Hay and forage crops, including the duplicated beet tops, grain, and pea straw and some alfalfa pasture, were valued at $540,734.17, or $21.25 an acre from the 25,443 acres planted in these crops. The 127 acres of gardens planted on the project produced crops considered worth $24,738 or $195.42 an acre.

KANSAS Pioneers in *Irrigation*

by WILLIAM C. BRADY

Area Planning Engineer, Kansas River District, Topeka, Kans., Region VII

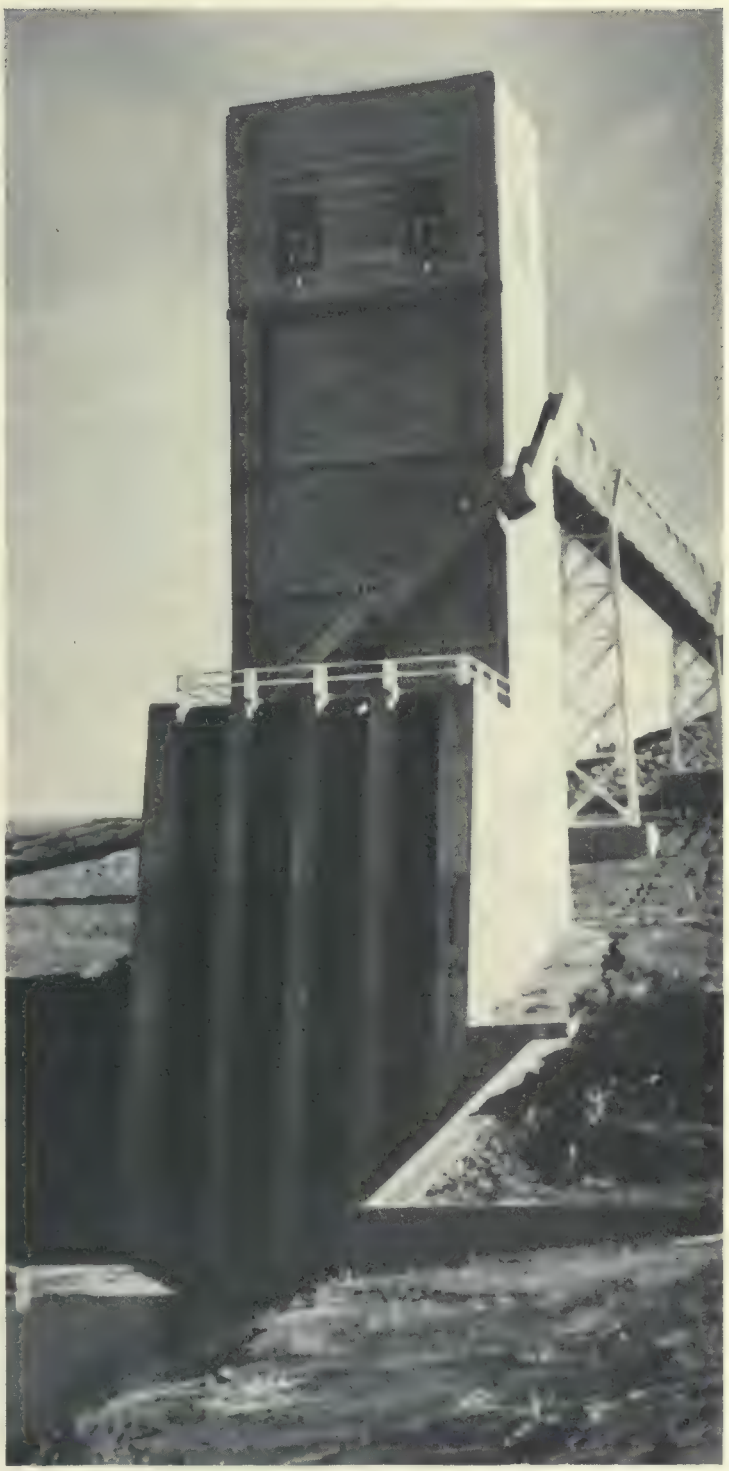
The years roll by, the wars take their tolls, and millions are left in hunger and want. Kansas, the greatest wheat producing State in the Union, continues to do its magnificent part in feeding our great Nation and those foreign nations in need of our help.

There are periods of plenty and periods of drought. There are wet years which produce an excess of crops which are shipped to other areas. There are many years in which there is sufficient rainfall to grow most crops, but during some years there is no rain during the growing season when it is most needed. Then there are dry years when nothing is raised. Day after day the sun beats down, dries up the land, withers the crops, and leaves them begging for water. This is the time when everyone realizes there is a need to utilize to their fullest extent mother nature's gifts to this earth; to nurture and protect what one has, and to produce good fields of corn and forage to feed the cattle. In the final analysis, these needs call for a crop insurance to protect one's interests, and with this insurance, the opportunity to plan for the future by using experiences of the past.

The Indians made a success of irrigation in Kansas as far back as 1650. A small band was driven out of its home in New Mexico, by the Spaniards, and migrated to the beautiful valley that is the present site of Scott County State Park. Here the Indians found an abundant spring, which they diverted, and set up a small irrigation system to water their crops. They lived there peaceably for a few years, and their descendents would probably be there yet except for the Spaniards who had followed them. The Spaniards were not particularly interested in the welfare of the natives. They were after gold, and could not be bothered by any scruples as to how they got it. They destroyed the Pueblo in the valley, and drove the Indians back to Taos, N. Mex.

Many decades later, white settlers moved into this valley and found the ruins of the Pueblo, with evidences of the irrigation that the Indians had done. They cleaned out the Indians' ditches and reconditioned them for their own use. The early American Indian, as primitive as he was, believed in irrigation and passed his meager knowledge on to the white man.

At Old Fort Wallace, located on the Smoky Hill River near the mouth of Rose Creek and the present town of Wallace in Wallace County, the early settlers and soldiers of the fort also



Intake tower, Kanopolis Dam, Kans., now under construction by the Corps of Engineers.

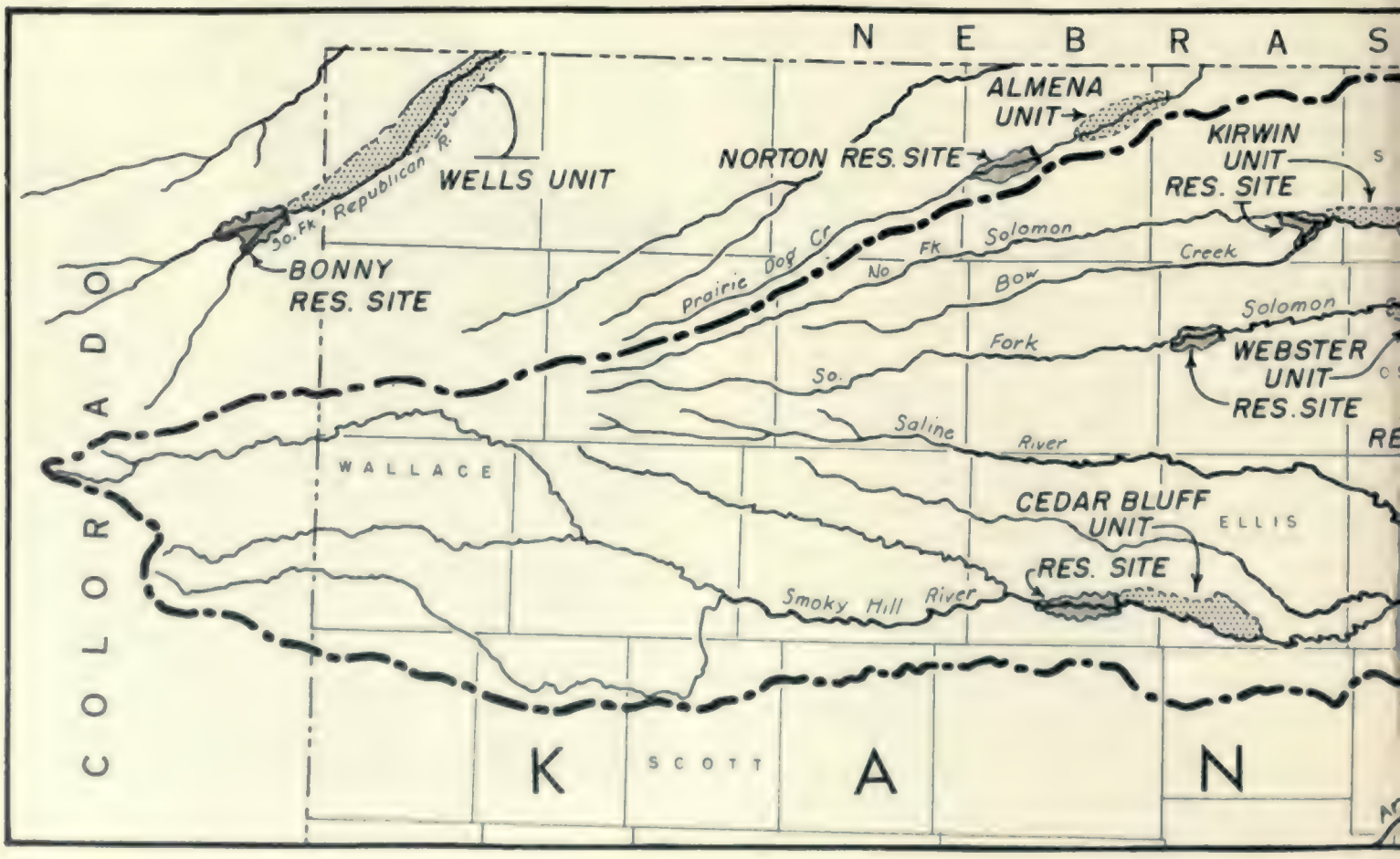
realized the value of irrigation. Most of them had come from far Eastern States, where they left green fields and pastures, to open this great territory of the West. They saw the need for supplemental water in this semiarid region. In 1870, a visitor to the fort reported as follows:

"The water of the Smoky here (Fort Wallace) runs quite a stream. Across it the soldiers have made a dam, which not only furnishes water for the fort, but ice in winter and a chance for irrigation, which opportunity is used to fertilize a garden of about 4 acres, in which they grow all kinds of vegetables, melons, etc." (Excerpted from the Western Home Journal, Lawrence, Kans.—1870—From the files of the Kansas State Historical Society.)

The State of Kansas has had its trials and tribulations, has conquered its problems of the past, and has emerged a leader in this great commonwealth of States. During the middle and late thirties, Kansas experienced a period of very severe drought. There were many months of little or no rainfall whatsoever. During the growing season for the years 1934 through 1938 at Salina, Kans., there were 19 extended dry periods, in which time one-half inch or less of precipitation fell in 20 or more consecutive days. Some of these periods continued for as long as 50 consecutive days. Farther west, at Hays, the conditions were still more severe. In the summer months, during these periods of drought, the temperatures ranged from the nineties to extremes of 121°. Many tried and true homesteaders, who loved Kansas, left their homes and farms because they could no longer survive there. They had no feed for their livestock, so thousands of head of cattle were killed. A few people moved to States where they were able to raise better crops and could feed their stock. Many other farmers had to sell their valuable herds of purebred cattle very cheaply or lose them to the ravages of nature. There were many who migrated who would have stayed on their land and kept their cattle if there had been any facilities available for storing and using water to raise forage.

This severe drought of the thirties convinced many of the need of irrigation. It created a lasting impression, and issued a challenge to those interested in the future of their land. This challenge was met by a few pioneers of irrigation on an untried and experimental basis. As an outgrowth of the efforts of these pioneers, their neighbors have seen the remarkable results obtained, and crop insurance by irrigation is spreading.

In the town of Downs in Osborne County, Kans., one often hears of Bas Verhage who irrigates 120 acres. (See April Reclamation Era for "A Corn King in Wheat Country"). In 1946, he made 102 bushels of hybrid corn to the acre and duplicated the feat in 1947, an extremely dry year. He became interested in irrigation a number of years ago and irrigated alfalfa for a while before turning to corn. When his neighbors saw the results that Bas Verhage got from his irrigated corn, they became seriously interested and started experimenting for themselves. These attempts to better their crop production proved very beneficial, and many are increasing the number of acres which they originally had under irrigation. The farmers in this region are irrigating mostly hybrid corn, alfalfa, grain, and forage sorghums, and getting most satisfactory results. The irrigated land is yielding



from 55 to over a 100 bushels of corn to the acre. Some nonirrigated bottom land in the same area last year produced from 10 to 20 bushels per acre, while upland and other bottom land had a complete crop failure. This is proof enough for them.

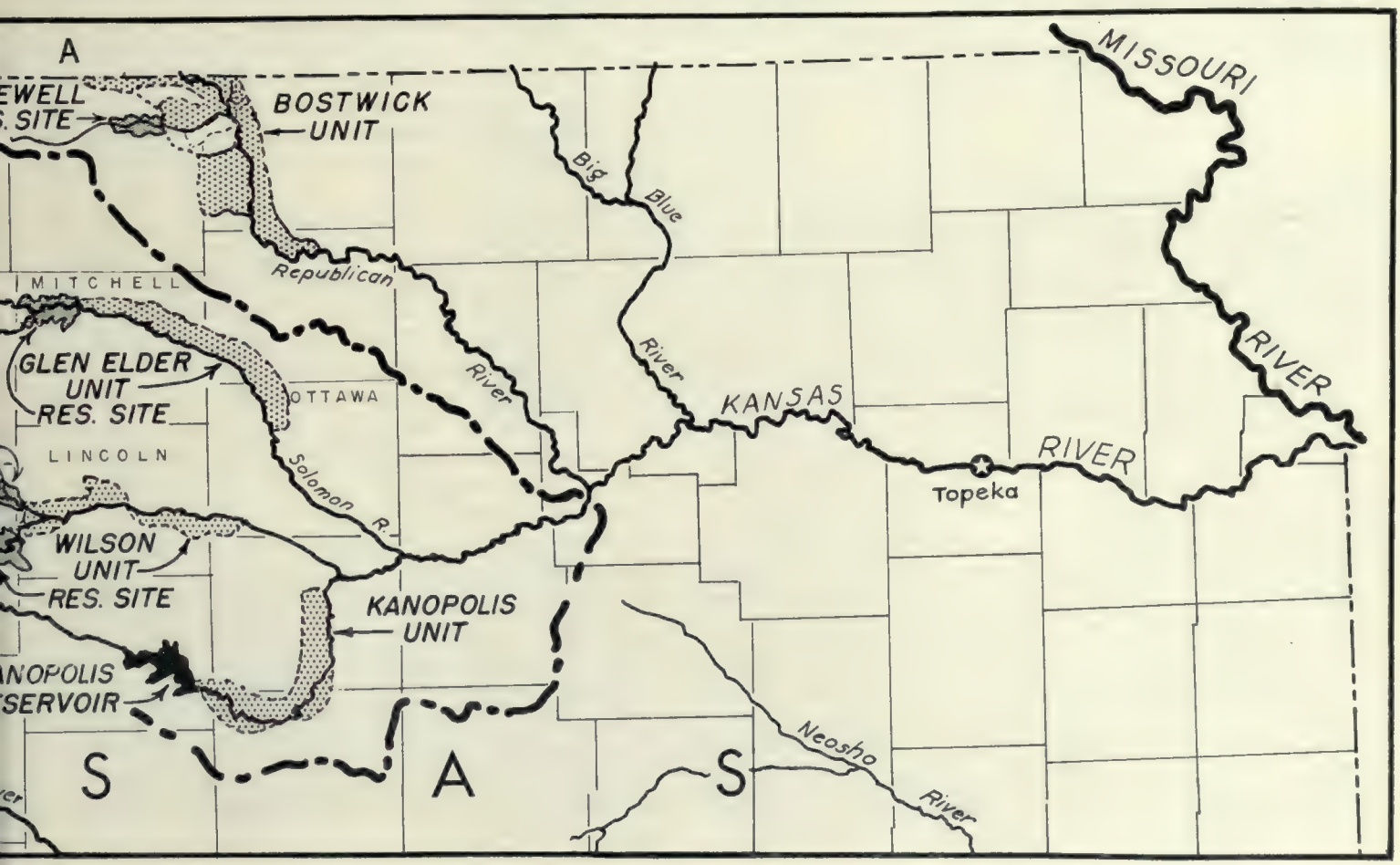
The trend toward irrigation in the Downs area can best be shown by the number of irrigation pumping units sold by Mr. Harm Voss in his farm implement business at Downs. In 1947 he received 29 irrigation pumping units which were readily sold. He has been promised delivery for 11 plants early in 1948 which are already sold. He feels that he could sell an unlimited number of these units in the near future, if he could be supplied by the manufacturers.

The values and benefits derived from irrigation are further shown in this county. Mr. J. C. Stephenson, who owns a herd of purebred livestock, planted 5 acres of alfalfa which he irrigated in 1947. He was very proud of the quality and production achieved and the Osborne County agent is using picture slides and comparison values obtained from this alfalfa stand to indicate to other farmers the gains that can be made by irrigating.

These pioneers of irrigation in Kansas, in Smith and Osborne Counties, have watched and studied the irrigation experiments of their neighbors. They have become convinced that irrigation yields promising results, and are endeavoring to get water, which is scarce in this section especially during dry periods, from whatever source available. For this reason, they are pumping from rivers, creeks, and farm ponds to irrigate their crops. Several have proved to themselves that the benefits derived from irrigation in only one dry season will easily offset the extra expense incurred in building a small creek dam, and pumping from this small reservoir to their land.

As one continues farther east along the Solomon River, there are irrigators near Beloit in Mitchell County and near Minneapolis in Ottawa County. There are irrigators on the Saline River, near Sylvan Grove, in Lincoln County. In Ellis County, on Big Creek alone, there are 18 irrigators between the towns of Ellis and Hays, and several on the Smoky Hill River near Russell with others on down the river to Junction City.

East of this basin along the Kansas River (locally called the Kaw River) there are irrigation farmers in areas which have an average rainfall of 32 inches or better per year. One of these irrigators, Mr. Howard Jackson, who farms in the Kaw Valley near the State Capitol at Topeka, started irrigating in 1932 and since then has used water every year except one. He has obtained corn yields of 75 to 100 bushels per acre, while his neighbors who did not irrigate were getting less than 25 bushels. Some even had complete crop failures. Mr. Preston Hale, the Shawnee County agent, has knowledge of at least 35 such irrigation farms in this high rainfall area that make a practice of annually insuring their corn, potatoes, and vegetable crops by irrigation and are receiving dividends in increased crop yields. The Topeka and Salina Chambers of Commerce are both promoting experimental irrigation for the 1948 crop season in their respective areas. They know the value of irrigation, even in these high rainfall areas which frequently experience a rainless period of 20 or more consecutive days in a normal rainfall year.



"See the difference!" says J. C. Stephenson, holding alfalfa grown on his farm just east of Downs, Kansas. His right hand holds alfalfa grown on a nonirrigated section, and his left holds the irrigated variety. He raised four times as much alfalfa under irrigation.

Irrigation in Kansas, as elsewhere, presents its problems. These are recognized by workers at both Kansas State College and the Kansas Extension Service at Manhattan, who are experimenting with diversified farming and various ways of irrigating in order to be able to help the Kansas irrigator. They are also determining the best crops which will readily respond to irrigation, and are making estimates of the approximate costs for various types of irrigation.

The Smoky Hill Basin is comprised of the Smoky Hill River which rises in eastern Colorado and flows eastward about 320 miles to its confluence with the Republican River at Junction City, Kans., to form the Kansas River. Forty to fifty miles west of Junction City, the Smoky Hill River is joined by the Saline and Solomon Rivers, its principal tributaries. As the Kansas River flows eastward it becomes a direct tributary to the Missouri River at Kansas City.

The State of Kansas is an integral part of that group of 17 Western States which are included in the National Reclamation Act. It was therefore inevitable that the influence and results obtained by these pioneers of irrigation in Kansas would further the needs for more irrigated land in the Smoky Hill River Basin, and has resulted in the basin being included in, and becoming an important part of, the vast Missouri Basin Project to utilize water, conserve land, and stabilize industry and agriculture in the Midwest by storing and using flood waters that now cause tremendous damage on their long journey to the ocean.

That part of the Pick-Sloan plan which refers to the Smoky Hill Basin in Kansas includes the development by irrigation of about some 120,000 acres by six units. Supplemental planning in this basin discloses several other smaller units that will probably increase the total irrigated area by several thousand acres. Many people of the basin are anxious for its early development both for irrigation, flood control, and other benefits, such as recreation. They realize that development by private initiative is very limited and that not much can be accomplished unless flood waters during wet periods can be stored for drier years.

The Kanopolis Dam, on the Smoky Hill River, being built primarily for flood control by the Corps of Engineers, is nearing completion and about 41,000 acres can be irrigated from this reservoir, since the Bureau of Reclamation will provide supplemental flood storage in its upstream Cedar Bluff Reservoir where another 11,500 acres can be irrigated. Irrigation districts and modern water appropriation laws are new to Kansas, but the people are proceeding with organizations of districts and determination of the legality of their laws in order to get the Missouri River Basin project in Kansas constructed and put to useful purposes. Once this is accomplished, the Smoky Hill Basin may well justify the faith of those hardy pioneers who believed in, practiced and benefited by, irrigation farming in Kansas. END

Tomlinson in Italy

George E. Tomlinson, assisant director of the Branch of Project Planning, Bureau of Reclamation, was recently detailed to the State Department to assist in planning proposed irrigation projects in Italy under the European Recovery Program.

During the latter part of April, Tomlinson and other members of the American committee of experts met with Italian experts, at which time a subcommittee was appointed to coordinate activities. Engineer Marco Visentini, President, Council for Public Works, was appointed the opposite (the Italian counterpart of the position) to Tomlinson. Engineer Visentini was also named chairman of the subcommittee. On field trips Engineer Francesco Sensidoni, Chief, Division Dams Council Public Works, will represent Visentini. Counsel Loni of the Foreign Office and Mr. Brand of American Embassy will be present on all field trips.

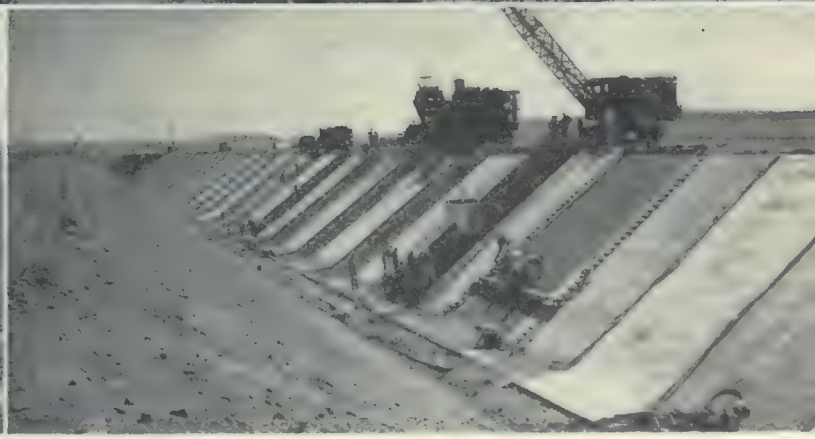
The Working Subcommittee left Rome by air April 21 for a 4-day inspection of reclamation and power projects in Sardini. After a short meeting on their return to Rome on April 25 they left by air for an extended trip through Puglia, Lucania, and Calabria, including visits to Tavogliere, Metaponto, Sibari, Neto River, and San Eufemia land reclamation projects and to dam developments in Sinni and Crato Rivers and on La Sila Mountain. A 4-day trip to Sicily followed after which the group was scheduled to return to Rome on May 6 for a final meeting of the whole committee and the preparation of reports.

"the Land of Dreams Come True"

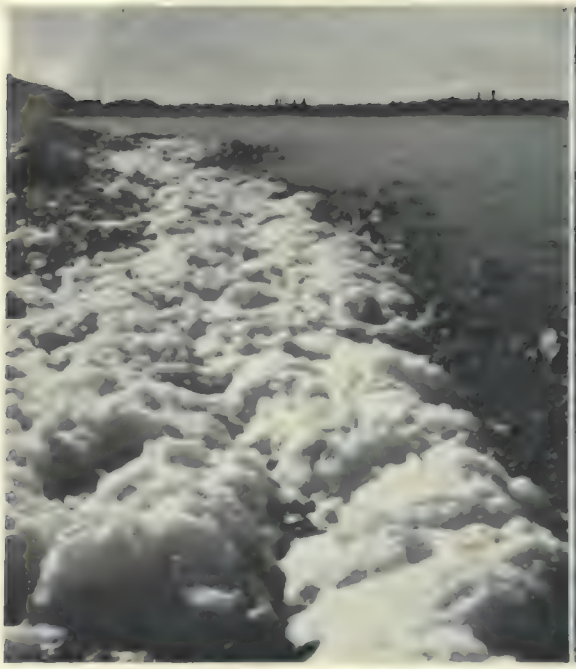
by Elma Hill Neal

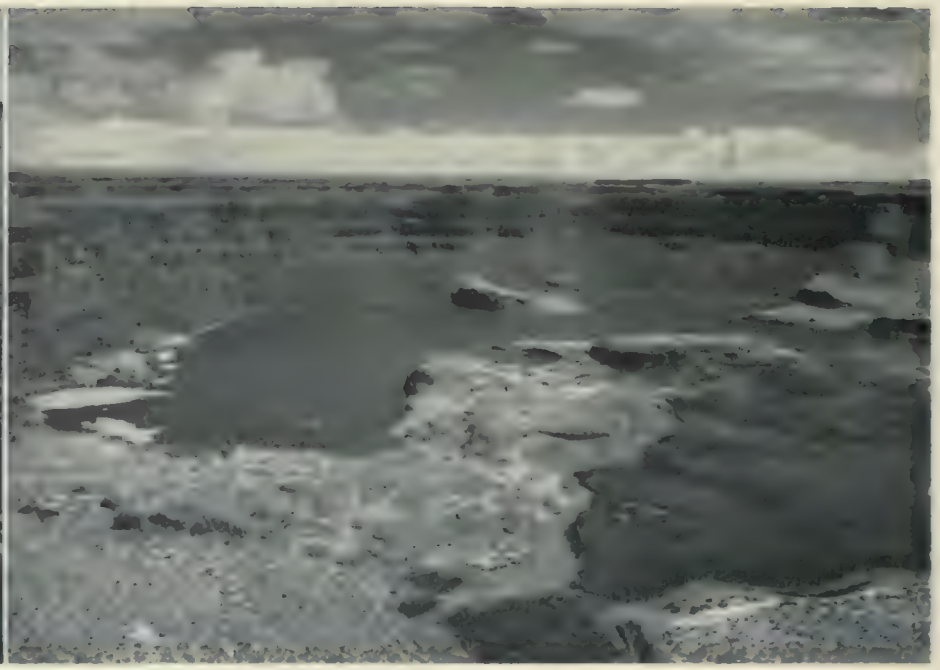
WHEN I WAS A LITTLE GIRL, my lessons in geography were made interesting by a teacher who gave us descriptive names for the States. The State of Washington was known as the "Evergreen State." We dwelt extensively upon the verdant rain-ridden coast country, with its big cities, and the Cascade Mountains with their mighty stands of Douglas Fir and Ponderosa Pine.

Little was said of the huge interior of the State—of that great Columbia Plateau country that spreads itself like a vast Mesopotamia cradled in a giant bend of the Columbia River. In fact, little could be said of that country, for it was a contradiction of wasteland, a nonproductive region that lay like a barrier between the rolling Palouse wheatlands of eastern Washington and the mountains. Even the pioneers skirted their crawling caravans far to the south.



"In this barren desert, engineering and agriculture are joining hands in a manner that defies all known Hollywood adjectives." Dreams are coming true as one sees the sagebrush land plowed and leveled into fertile fenced fields while we witness the gigantic canal construction program which makes possible this miraculous conversion. Photo at top right by F. B. Pomeroy, others by A. W. Bauman, Region I.





Left: "Soapsuds" fringe the water at Soap Lake, Wash., a common scene when water has been churned all night by high velocity winds, especially in cold weather. Town of Soap Lake is in the background. *Right: "Spectacular Dry Falls, where the Columbia was once a mighty cataract that dropped more than 400 feet, with the power of a hundred Niagaras."* Right photo by A. W. Bauman, left photo by Harold E. Foss, Region I.

The geography books written for my grandchildren will tell a far different story. And there are many reasons why.

For it is in this barren desert that engineering and agriculture are joining hands in a manner that defies all known Hollywood adjectives. From the town of Pasco, where the waters of the Snake flow peacefully into the broad Columbia northward, the country shows signs of the breaking up of the old order.

Probably to no greater extent on the face of the globe does the spirit of the twentieth century show itself than in this corner of the world. Across the Columbia, north and west, is the atomic bomb plant at Hanford, with its mushroom town of Richland and intervening villages of tents and trailer houses. Fanning out, north and east of the Columbia, is the Columbia Basin project. And in this respect, it is still a land of contradiction, for potential destruction and construction are only a river-breadth apart.

Across the project, one travels a broad, oiled highway that winds in and around outcroppings of lava, over rolling hills and across Paradise Flats, which is so named for no obvious reason. One passes between clusters of houses on either side of the road that present a bedraggled, defeated appearance, but are nevertheless full of possibilities. At least one or more lively towns are expected to spring up in their vicinity, for the soil is a light volcanic ash and when properly watered is capable of producing bumper crops. It is the land of imagination, without a thing in the world to harness one's dreams, a wide, limitless expanse, desert today—but what, tomorrow?

It is said Mount Rainier can be seen to the southwest, and with the aid of one's imagination, there it is, snowcapped, high and alone in the haze, where the sky and the earth come together. And to make a pseudo Flash Gordon scene a little more real, out of the distance come striding the towers of a transmission line, with its hundreds of thousands of kilowatts of power, promenading all the way from the Grand Coulee Dam to Portland, Oreg.

As we pass under the wires of these luminous, straddling skeletons, a minor inward panic suddenly possesses me. They represent power beyond imagination. They are indicative of the change that will come all over this country that has been used to nothing more significant than a lone, lurking coyote or a shy, loping jackrabbit. One looks and thinks, and thinks and looks, until the mind is weary from the enlarging projection.

One center of Bureau of Reclamation activities is located at Ephrata, probably named for a small town in Pennsylvania years back, and which today is often mispronounced and misspelled. Possibly the spelling is subconsciously confused with the Euphrates River in Asia that was supposed to have formed one of the boundaries of the Garden of Eden. The Book of Genesis tells us that it was well-watered and a pleasant place to dwell. Needless to say this has a psychological bearing, for it is in Ephrata, Wash., that there is a concentration of people, who, because of their close association with the idea and their unflagging efforts, see a vision of Edenlike productivity for this region.

It was a sleepy little dry-farming town, nestled under a protecting sagebrush ridge at the turn of the century. It is now expanding mightily. There is no slum district and its wide streets are lined with modernly constructed business blocks. Its residential sections are laid out with a future in view. Because of its long hot summers, almost anything from semitropical plants to fir trees beautify the gardens and landscapes. There is a subdued excitement in the air, for everyone is living with a plan. Other towns are similarly affected—Moses Lake, Soap Lake, Quincy, Othello, and several more.

Beyond Ephrata, the road takes to the Grand Coulee, and

what a grand coulee it is! To most people, a coulee is a rather romantic name given a topographical peculiarity in a Zane Grey novel. Cattle were supposed to graze on abundant sweet grass that grew on its floor and waterfalls spurted over its embankments. The Grand Coulee is all this and more.

It is the grandest coulee of all. Its bottom is a series of lakes, from Soap Lake to the impounded waters at the South dam, for it is the remnant of the Columbia of a past geologic age. As one nears it, he is struck by the purple-blue haze that hangs over it and the great ramparts of columnar basalt that rise like battlements. At intervals, what appear at first to be tiny waterfalls, but which, at closer view, become streams of hundreds of inches of water, are flung in filmy veils over the walls. Some are sparkling clear with a rainbow shimmering on their surface. Others are like giant handfuls of muddy water scattering a dusty spray. Every curve in the coulee wall reveals a changing panorama of wonder and awe.

About 20 miles from Soap Lake is the spectacular Dry Falls, where the Columbia was once a mighty cataract that dropped more than 400 feet, with the power of a hundred Niagaras. One climbs the grade and looks out over a desolate parapet of the Coulee to the peaceful lakes that have formed in the potholes of the old glacier-fed river. Here the Coulee is 3 miles wide. Here the past is evident to one who knows no geology.

But farther up at Grand Coulee dam, the future is so evident that one need not be an engineer or an expert agriculturist to sense the import. All the surrounding scenery is dwarfed by the gigantic dam. Ordinary sound is blotted out with the crushing roar of the waters. One little mind is weazened by the combined intellectual effort behind the colossal plan. The vibrations reach out and one's very soul quivers.

I could go into infinite detail and tell of the millions of tons of water that will be backed up into the old coulee; of the enormous Bacon Tunnel that is already under construction; of the huge siphons that will carry irrigation water through the low places; of the monstrous machinery that is used, one machine in particular that lines a 50-foot canal with concrete at one swoop, like a painter making a sweep with his brush. But I will leave that to the planners and the economists and those who love the exact sciences.

I carried away with me two big ideas that can be simply told.

I was impressed with the fact that any great creative force of nature is a challenge to man, and how near he approaches God in his combined strategy and tactics. The other idea is just as big and requires as much effort, but is the endeavor of a century. It is a slow process of labor and love.

For in this land of imagination where dreams are coming true, one sees the sagebrush land plowed and leveled off into fertile fenced fields. One sees a homeland dotted with houses, wherein babies grow to youth and maturity sustained by the land that will produce wheat and potatoes and sugar beets and corn. One can feel the leafy coolness of trees in summer and hear the ripple of water in an irrigating ditch that was once snow in the Selkirks. One sees the Evergreen State completely evergreen. One sees security and peace in a world hungry for both. END

The first delivery of irrigation water to the Columbia Basin project lands occurred on May 15, when water began to flow on the Pasco Unit, just 44 years after the first investigation had been made by Reclamation engineers to determine the future of the Columbia Basin area. The Pasco Unit, No. 1 block in the project, will ultimately embrace an area of approximately 5,600 acres. By 1952, according to the plans, water will be available for 216,000 acres in the project. A complete account of the Pasco event will appear in next month's issue.

"In this land of imagination one sees security and peace in a world hungry for both." **Kenneth Hampton, manager of the Bureau's experimental farm at Moses Lake, his daughter Kathleen, and Mrs. Hampton walk through a field of netted gem potatoes, with hybrid corn in background. Photo by A. W. Bauman, Region I.**

DRAINAGE PROBLEMS

in the Rio Grande Valley

by CHARLES R. MAIERHOFER, Engineer, McAllen, Tex., Region V

THE DRAINAGE PROBLEM is the most serious threat to local economy that has ever faced the valley.

This is a strong statement. Yet only a few men take the condition seriously, and at present an air of complacency prevails.

This is probably based on inflated incomes from agricultural products—the valley's good fortune in the last years. It is human nature to feel secure while one's income exceeds all previous expectations.

When our water supply problems are *solved*, we will not be worse off for having had the problem. When the local marketing and maturity problems have become a memory, there will remain no permanent mark affecting the lives of future generations. But deterioration of lands due to inadequate, improper, and insufficient drainage, cannot be classed with the problems just mentioned. Reclamation of salted and waterlogged lands is generally slow and costly. Some lands can never be returned to their original productive capacities.

The results of continued neglect of drainage will leave a permanent scar on a valuable resource—a mark against the men who have profitably used this area for the past 40 years and to whom the next generation can point an accusing finger and say that we have not kept faith with nature. We have upset the balance.

Other irrigated areas—Babylon, Egypt, the European lowlands—have left their indelible and tragic marks to prove this to be true. Even our own Southwest rose and fell in a cycle parallel to its irrigation development before recorded history.

In order to understand the drainage problems of the valley, we must know the conditions contributing to them. The most important are:

- The "water table."
- Accumulations of salts in the soil.
- Present operations.

Let us examine these problems individually.

The Water Table

The term "water table" is generally taken to mean the surface of free water in a hole, well, or pond deep enough to collect water from subsurface sources. This is a static level; that is, the point at which the water comes to rest after the well is drilled.

The water table in the valley is not found as a level surface, but is generally undulating or wavy. The valley water table slopes generally from west to east, except north of La Feria and Harlingen, where it slopes to the northeast.

Most irrigated valley lands have a water table near enough to the surface to require additional drainage works. A total of 552,000 acres is irrigated. During the 12-month period ending September 1947, the area having a water table within 5 feet of the surface varied from a minimum of 110,000 acres to a maximum of 245,000 acres.

This area, 245,000 acres, undoubtedly requires immediate attention. Investigations have shown that rainfall and irrigation determine the extent of such areas. In September 1946, after an extended dry period when transpiration and evaporation were at a maximum, and the river flow was low, less than 50,000 acres had ground water within 5 feet of the surface.

After general rains late in that month, the area increased to 200,000 acres.

Again in July 1947, after an extended dry period, the area with ground water within 5 feet of the surface was comparatively low, 127,000 acres, as compared to the previous low of 50,000 acres in September 1946. In August 1947, heavy rains again occurred. After these rains, the area increased to 245,000 acres as compared to the previous high of 200,000 acres with dangerously high ground waters.

What could be more conclusive? Yet, it is easy to forget. The significant fact is that each year, the water table mushrooms. Every high-and-low cycle finds the "floor" of the water table rising a little higher, and the "ceiling" moving upward. The much-to-be-desired September 1946 low of 50,000 acres may never exist again unless extensive remedial measures are taken to relieve the cause of high ground water with its adverse effects.

Accumulation of Salts in the Soil

Excessive quantities of salt injurious to plant growth are found in many areas. Areas with such salt accretions correspond to those where saline ground water has been near the surface over extended periods. Where ground water lies at a safe depth, no appreciable quantities of salt are found.

The major cause of the increasing salinity within the root zone of plants and at the surface of the soil, is the physical phenomenon of capillarity. This force is continually bringing the highly mineralized water upward through the soil from the existing water table. In areas where a high water table exists, the water is being forced upward until it reaches the surface where it evaporates, leaving its heavy salt load.

Under such conditions productive lands soon become barren.

It is evident that salts in valley soils originate from the Rio Grande through irrigation. Available data indicate that before irrigation was practiced, valley soils in a typical area of approximately 155,000 acres averaged only about 0.05 percent of soluble salts. By 1925 this concentration had reached 0.13 percent. In 1945 it was 0.28 percent. During periods of excessive precipitation, the ground water in this area is less than 3 feet from the surface over about a third of the area, and less than 5 feet over most of the remainder.

During the period 1925 to 1945, while salt content of the soil in a part of the valley more than doubled, it is estimated that losses in income amounted to $400 per acre.

At the present rate of deterioration, a complete drainage system, including tile on 200 feet spacing, the necessary outlet drains, and lateral drains at one-half mile spacing, can be paid for with the sum equivalent to the losses in the past 6 years. It is hoped that property owners who feel that they cannot afford the necessary drainage works will seriously consider these statements.

Analyses of salt crusts at the surface of valley soil indicate a predominance of soluble calcium salts, principally calcium chloride which is readily soluble. In addition, calcium ions are generally considered as having a preservative and restorative effect on the physical properties of soil. Fortunately no "black alkali" (sodium carbonate) has been found.

The general status of valley soils with respect to soluble salt content, then, does not present a hopeless problem. From a physical standpoint, reclamation is practical, and, when satisfactory drainage conditions prevail, the seriousness of the salinity problem can be greatly reduced. The problem is serious, and reclamation will be slow and costly, but, from an economic standpoint, it is feasible and should be vigorously pursued in order that productive ability be not further lowered.

Present Operations and John Doe

The problem "present operations" has been so termed for want of a more descriptive name. It is a very important problem, however, so I will attempt to define it more clearly by an actual case.

John Doe, as we will call him, lives in another State. He was reared on a farm but has been working in a large city for about 20 years. During this time he saved some money, enough to fulfill a lifelong ambition of owning his own farm. After looking around the country, he decided that the Rio Grande Valley was the place to spend the rest of his life. This was in 1944.

Mr. Doe invested his life's savings in 18 acres of 4-year-old orange and grapefruit trees. The soil was fine sandy loam, and the trees looked good. John took no chances in buying this land, because it was sold to him by an old and trusted friend. The friend acted in good faith.

In the early spring of 1946, it was still cold where John lived. He and Mrs. Doe thought it would be nice to visit the valley, inspect their orchard, let their snow-bound bones soak up some sunshine, and begin making plans for building a home on the tract. When they saw their place, they noticed several of the young trees were dying. They didn't worry about this and had them replanted. Then the grove looked fine again. Because building costs were still high, the Does went home, planning to return the next spring.

DEATH STRIKES in unusual fashion. This orchard in the Fort Sumner project, New Mexico, was the victim of too much water. Seepage started 30 to 60 days after water was released from the main canal, approximately ¼ mile from the orchard, and killed all but six trees. Photo by A. E. McCloud, former Region V photographer.

Grove not the Same

In March 1947, the Does returned to the valley. Their grove didn't look the same. Many more of the trees were dead. Mr. Doe was very concerned. He inquired among local people and found that the valley had what was called a "water table." He also found that when a high water table existed, the land became "salty" and trees died. Upon inquiring further, he was told that all one had to do to relieve such a situation was to install a tile drainage system. He found that costs were not excessive compared to his investment in the land. Mr. Doe felt better. He contracted to have the work done by a man who said he could put the grove back in good condition.

At this point the Bureau of Reclamation with which I am connected asked Mr. Doe if he objected to our making some studies to determine the value of the work. We had no desire or authority to influence the methods or location of the system. Our information would be confidential and available to Mr. Doe alone. He was very pleased and offered his full cooperation.

A study of the soils showed the top foot to be sandy loam, the next 4 feet to be sandy clay loam with only a small percentage of clay. Thus, the top 5 feet were readily permeable. Below these soils were relatively impervious clays for at least 22 feet.

Ground-water studies showed depths to range between 5 to 6 feet from the surface over most of the area. Ground-water movements were found to be toward three well-defined points within the grove. Capillarity was at work as indicated by surface moisture over most of the tract.

Soluble salt studies of the soils showed concentrations to be high.

General Kuldell (see "Too Much Water," *Reclamation Era*, September 1947) inspects a part of the drainage system he designed for his Chenango plantation, near Brazoria County, Tex. Cattle now thrive on these lands which had been so depleted by the production of sugarcane and cotton. Photo by Dale A. Hovey, formerly of Region V.

The tiles were placed at a depth of about 7 feet, or about 2 feet in the impervious clay. This depth was used because the contractor had used it successfully in other areas. Certainly no consideration was given to soil textures. While the trench was being dug, there was a very appreciable flow of ground water into it, indicating that conditions were conducive to rapid and effective drainage reclamation.

After the trenches were completed, the tiles were carelessly laid in one or two feet of muddy water, as the outlet was kept closed. There was no way of knowing whether or not alignment was satisfactory. If one tile near the outlet end had been placed off-line the whole system would be entirely ineffective.

To cap off this series of malpractices, the impervious portion of the excavated material was used for the initial backfill. If this did not entirely seal the joints between the tile, the method used in completing the back fill certainly did. The trench was filled by dumping the excavated material into the several feet of water in the ditch. This corresponds to a method purposely used when impervious backfills are desirable, and is known as "puddling."

Since completion, the system has been carefully observed, and ground-water studies have been made monthly. After 7 months, the tile line has remained dry, even though there are 2 feet of saturated soil above; no flow has been recorded at the outlet, and water table has steadily risen. There is obviously no need to check salt contents of the soil. When Mr. Doe visited the valley last August, he was a thoroughly disillusioned man.

It is not to be inferred that such methods are used in every case. Certainly some well qualified engineers and responsible contractors in the valley do work of the first order. The fact remains, however, that for each subsurface drain in the valley that functions properly, there are one or more which do not.

Causes Evident—Basic Research Necessary

The causes for this are evident. A negligible amount of basic research concerning proper drainage practices under local soil conditions has been performed. Intensive research is not only desirable but necessary, in order that consultants can be given a course to follow in designing drainage works. This is not an individual problem, but one requiring the concerted effort of all people in the valley associated with agriculture. We must educate ourselves to turn to reliable professional men and public agencies for the answers. Only in this way can reclamation be effected within the ability of the lands to repay. The valley cannot afford one drainage system which does not function and later another which does. Every dollar spent must yield results.

Four-Point Drainage Program

Here is a basic four-point program toward solving our drainage problem:

1. Outlet designs.—Construct in the most rapid, economical, and feasible manner, a system of deep outlet drains. This is fundamental, as surface and ground waters must be moved out of the area.

2. Lateral drains.—Coordinated with excavation of the outlet drains, diligently pursue a program of lateral drain construction. This will require the closest cooperation between the landowners and their irrigation district officials. Each problem area must be provided with suitable outlets for farm unit drains.

3. Education.—The outlet and lateral drains systems will show a striking improvement in many areas. These improvements will form a nucleus for an educational program whereby landowners can be shown the valuable results of drainage. When the farmers become convinced that expenditures for drainage works will yield increased returns, their participation will be assured.

4. Research.—A program of subsurface drainage research is imperative. Little is known as to proper depth, spacing, and type of drains to be provided for best results. Practically nothing has been done to determine the value of pumping from wells to relieve local ground-water conditions. Certain characteristics of valley soils indicate that this method may prove to be more desirable than drains in many areas.

For these reasons, it would appear wise to move slowly on subsurface drainage construction until more facts are established.

The problem is in your hands. The task is great, but not hopeless. END

(This article is adapted from a paper presented at the annual Citrus and Vegetable Institute, November 18, 1947, at Weslaco, by the author. The institute was sponsored by the Rio Grande Horticultural Club and the Texas Extension Service.)

News Round-up

Second Year Brings Four-Fold Increase

A return of almost four times the gross per acre crop value was recently reported by the north unit of the Deschutes project in Oregon. This is the north unit's second year of Reclamation-served irrigation water.

In 1946, the first year the north unit received water from Bureau facilities, 6,988.5 acres were irrigated and the average gross per acre was $27.82, while in 1947, project farmers brought 13,497.7 acres under irrigation and realized a gross value return of $99.97 for each acre.

Science to Solve Silt Problem

A scientific survey by the combined technical forces of the Departments of the Interior and the Navy has been started at Lake Mead, created by Hoover Dam, to determine what sedimentation is going to do to the world's largest artificial lake. (See *Life of Hoover Dam*, April 1948 ERA.)

A miniature fleet has been transported by the Navy overland 300 miles to the middle of the desert in Arizona-Nevada. The "fleet" is being manned by a lieutenant and six chief petty officers who have been assigned to the survey by the Navy Bureau of Ordnance from its ordnance disposal unit at Indian Head, Md. Especially trained scientific technicians are being made available from the Navy's Electronics Laboratory, San Diego, Calif., and its Underwater Sound Laboratory, New London, Conn. Engineers and geologists of the Interior Department's Geological Survey and the Bureau of Reclamation have general technical responsibility for the investigation on the key reservoir in the multi-million-dollar reclamation development in the Southwest.

When work is completed, in approximately 10 months, the Bureau of Reclamation expects to have answers to many of the operating questions posed by the steady accumulation of sediment in the 32,000,000-acre-feet-capacity reservoir. On the basis of these answers, the Bureau will know the volume of water available for power production at various reservoir levels and for water releases for irrigation and flood control.

Corfitzen Named Commissioner of Water Economy in Greece

W. E. Corfitzen, experienced water resources engineer of the staff of the American Mission for Aid to Greece, has been appointed Commissioner of Water Economy in the new Directorate of Water Economy in Greece.

Mr. Cortfitzen will assist in the selection of reclamation projects and in the training of Greek personnel in modern techniques. He has been working in Greece under the direction of the U. S. Army Corps of Engineers since last fall. He was loaned to the American Mission by the Bureau of Reclamation, where he has been employed since 1933. In recent years, Mr. Corfitzen has worked with engineers of 31 nations who have asked the United States for help in developing reclamation programs. He was a frequent contributor to the RECLAMATION ERA and has been instrumental in arranging for the exchange of information regarding reclamation between many foreign countries and the Bureau.

The cooperative reclamation program is the result of an agreement completed in March 1948 by the American Mission and the Greek Government. The program is designed to increase domestic food production by bringing more land under cultivation. The program will be administered by a new directorate that previously handled hydraulic projects. It will be financed by an allocation of 19,705,000,000 drachmae from the AMAG consumer goods fund. The new agreement will make possible better coordination of the reclamation work already begun under the direction of the Ministry of Public Works. Reclamation projects in all parts of Greece have been supported by AMAG's 19,705,000,000 drachmae allocation since November 1947, a little more than $2,000,000 in United States Currency.

Warne Sees Hydro Power as Oil Conservation Measure

Assistant Secretary of the Interior William E. Warne in a recent discussion pertaining to the conservation of oil through the development of hydroelectric power in the Washington, Oregon, and California area said "It is estimated that by 1957 approximately 18,000,000,000 kilowatt-hours of hydroelectric energy can be produced annually in that area. Immediately upstream from Hoover Dam are undeveloped projects: Bridge Canyon with a proposed installation of 750,000 kilowatts, Kanab Creek with 1,250,000 kilowatts, and Glen Canyon with 400,000 kilowatts. The market which now absorbs 13,000,000,000 kilowatt-hours will require 25,000,000,000 kilowatt-hours by 1957, provided fuel or hydroelectric power for use on the Pacific coast and in the Southwest is no longer a question of conserving oil only; but it is also a question of either developing hydropower or retarding the growth of industry and population.

"The Federal Government under the existing critical fuel shortage and cost situation should not be in the position of having hydro developments trail the demand for energy. These developments should be made in advance of the market in order to relieve the fuel shortage to the extent possible in the coming decade and provide some leeway for national defense."

Plans for Interior Centennial

A Senate Joint Resolution (175) has been introduced by Senators Butler of Nebraska and Hatch of New Mexico to provide for the preparation and completion of plans for the observation on March 3, 1949, of the one-hundredth anniversary of the creation of the Department of the Interior as an executive department of the Federal Government.

Hungry Horse Contract Signed

When Secretary of the Interior J. A. Krug in Washington, D. C., signed the contract for the construction of the 520-foot Hungry Horse Dam, located on the south fork of the Flathead River, near Kalispell, Mont. on April 21, it marked the second largest contract in the 46-year history of the Bureau of Reclamation.

The $43,431,000 contract was awarded to the General Construction Co. of Seattle, Wash., The Shea Co. of Alahambra, Calif., and the Morrison-Knudsen Co., of Boise, Idaho. It provides for the construction of the fifth highest and fourth largest concrete dam in the world. It is estimated that it will take about 6 years to complete the dam and power plant, which will provide water for new hydroelectric power development, and other uses. It will firm the capacities of existing downstream hydroelectric power plants, and provide for flood control.

Irrigation lawmakers attend the signing of the Hungry Horse Dam contract, marking another milestone in the history of the project. Seated left to right, Senator James E. Murray of Montana, Secretary Krug, and Senator Zales N. Ecton of Montana. Standing left to right, Representative Henry M. Jackson and Senator Warren G. Magnuson of Washington, Representative Abe M. Goff of Idaho, Senator Joseph C. O'Mahoney of Wyoming, Representative Wesley A. D'Ewart of Montana, Representative Homer D. Angell of Oregon, Representative Walt Horan of Washington, Mr. James J. Sullivan, Administrative Assistant to Representative Mike Mansfield of Montana, Representative John Sanborn of Idaho, and Representatives Russell V. Mack and Homer R. Jones of Washington.

The signing of the contract was considered so important that the ceremony was attended by a large congressional delegation.

Commenting on the contract, Secretary Krug said, "this gigantic dam marks one of the greatest boosts for the growing economy of the Pacific Northwest to date, a region which is making unprecedented history in the development of the Nation. It will ultimately mean about a million kilowatts more firm power for an area whose homes and industries are already demanding more energy than is available, in addition to other benefits of river regulation."

Commissioner of Reclamation Michael W. Straus said, "Hungry Horse Dam is a key structure in the over-all, long-range development of the Columbia River Basin. The large increase in the firm power capacities of the power plants installed or likely to be installed downstream on the Columbia is a basic illustration of the value of coordinated reclamation development of the entire Basin. Integrated basin-wide development spells multiple benefits for all.

"Flood protection will be made a reality in the Kalispell Valley by the storage capacity in the reservoir back of Hungry Horse Dam."

Assistant Secretary of the Interior Wm. E. Warne, formerly Assistant Commissioner of the Bureau of Reclamation, and long an advocate of the project said, "The Hungry Horse power plant not only will be an important addition to the energy resources of the Columbia River Basin, which even now is experiencing a power shortage, but it also will serve a potentially important market in the general area which would encourage development of mineral resources such as silver, copper, lead, and alumina clays. There are stands of pulp timber nearby which, with reforestation, could produce 200 tons of paper a day if sufficient power is available."

Al Winkler, chairman, and Don Treloar, secretary, of the Flathead Valley Citizens Committee, Kalispell, Mont., wired their contgratulations and appreciation to Secretary Krug and Commissioner Straus on the splendid manner in which their staff carried forward the Hungry Horse project to the contract stage and called it a fine tribute to both of them as well as an example of good Government operation. They concluded by saying that untold benefits will come to the Nation from this great development. END

OUR BACK COVER

THE "RELUCTANT WATERFALL," better know as "Martin Falls" or the "Devils Punch Bowl." Spring thaws bring rushing waters over the Coulee walls while March winds blow the misty water back over the walls forming this waterfall in reverse. See "the Land of Dreams Come True," page 113. Photo was taken by F. B. Pomeroy, Region I, in March of this year.

Credit for Kansas

William C. Brady, author of Kansas Pioneers in Irrigation on page 109 of this issue, is also responsible for making arrangements for the appearance in the April issue of A Corn King in Wheat Country and for preparing the map on page 73 which accompanied that article.

The photographs which appear on pages 109 and 112 in connection with the current Kansas story are enlargements in black and white of Kodachrome slides submitted by Mr. Brady.

NOTES FOR CONTRACTORS

Contracts Awarded During April 1948

Specs. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2021	Davis Dam, Ariz	Apr. 27	Disconnecting switches for Parker switchyards	Delta-Star Electric Co., Chicago, Ill	$74,673
2026	Central Valley, Calif	Apr. 2	Lightning arrestors for Tracy switchyard and Elverta substation and meters for Shasta substation.	General Electric Co., Denver, Colo	31,204
2026	do	do	Instrument transformers for Shasta substation	Westinghouse Electric Corp., Denver, Colo	52,683
2056	Colorado-Big Thompson, Colo	Apr. 8	Electric elevator for Granby pumping plant	Otis Elevator Co., St. Louis, Mo	30,567
2059	Central Valley, Calif	do	Control boards for Tracy switchyard	Westinghouse Electric Corp., Denver, Colo	82,957
2059	do	Apr. 5	Unit substations for Tracy switchyard	Allis-Chalmers Mfg. Co., Denver, Colo	49,410
2062	Colorado-Big Thompson, Colo	Apr. 14	Power boards for Granby pumping plant	Cutler-Hammer, Inc., Milwaukee, Wis	10,581
2072	do	Apr. 13	Switchboards, battery chargers, and transformers for Marys Lake power plant.	Westinghouse Electric Corp., Denver, Colo	41,273
2072	do	Apr. 2	Control equipment for Marys Lake power plant	Control Corp., Minneapolis, Minn	13,275
2074	Central Valley, Calif	Apr. 22	Construction of 14.7 miles of Friant-Kern Canal	Otto B. Ashbach & Sons, Inc. and Steenberg Construction Co., St. Paul, Minn.	4,826,543
2077	Missouri Basin, N. Dak	Apr. 2	Construction of 7,500-kva. substation at Beulah	Elliott Construction Co., Omaha, Nebr	174,848
2096	Central Valley, Calif	do	Fixed wheel gate at Friant Dam	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	25,725
2104	Davis Dam, Ariz.-Wyo	Apr. 30	Construction of 5 22-foot diameter penstocks for Davis power plant.	Southwest Welding and Manufacturing Co., Alhambra, Calif.	935,000
2109	Lewiston, Orchards, Idaho	Apr. 5	Construction of chute and siphon	Poe Brothers, Clarkson, Wash	16,730
2110	Gila, Ariz	Apr. 13	Construction 4 residences and garages	H. P. Adams Construction Co., Yuma, Ariz	51,462
2112	Missouri Basin, Wyo	Apr. 5	4 tanks for Kortes power plant	Berkeley Steel Construction Co., Berkeley, Calif.	18,887
	Davis Dam, Ariz.-Nev	do	2 tanks for Tucson substation		
	Boise, Idaho	do	4 tanks for Anderson Ranch power plant		
	Columbia Basin, Wash	do	2 tanks for Grand Coulee power plant		
2115	Davis Dam, Ariz.-Nev	Apr. 20	Steel towers for 230-kilovolt Davis-Parker transmission line	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	470,941
2118	do	Apr. 1	Radial gates for Davis Dam	Virginia Bridge Co., Denver, Colo	84,000
2121	do	Apr. 29	Furnishing breaker, switches, and transformers, Tucson substation.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	20,888
2122	Hungry Horse, Mont	Apr. 21	Construction of Hungry Horse Dam, power plant, roads, and parking areas.	The General Construction Co., Shea Co., Morrison-Knudsen Co., Inc., Seattle, Wash.	43,431,000
2124	Lewiston Orchards, Idaho	Apr. 30	Equipment for Lewiston Orchards water treatment plant	Dorr Co., Inc., New York, N. Y	14,600
2125	Missouri Basin, Nebr.-Wyo	Apr. 2	Construction of Gering-Alliance and Cheyenne-Pine Bluffs 115-kilovolt transmission line.	Utilities Construction Co., Nashville, Tenn	663,252
2126	Boulder Canyon, Calif	Apr. 8	Construction of Unit No. 1, Coachella distribution system, All-American Canal.	American Pipe and Construction Co., Los Angeles, Calif.	1,593,462
2134	Colorado-Big Thompson, Colo	Apr. 23	3-84 inch butterfly valves for Estes power plant	Willamette Iron & Steel Co., Portland, Oreg	111,834
2140	Riverton, Wyo	Apr. 30	Construction of Wyoming Canal, station 1350+75 to station 1354+50, and Sheep Camp drain into Five Mile Creek.	James Trummel, Nyssa, Oreg	34,968
2140	do	Apr. 27	Construction of north pavillion lateral system	United Engineers, Inc., Ogden, Utah	219,900
2154	Columbia Basin, Wash	Apr. 30	6 Radial gate frames for Main Canal headworks	Geo. T. Gerhardt Co., Inc., San Francisco, Calif.	11,520
2156	Missouri Basin, Nebraska	Apr. 30	Construction of Oxford Siphon, station 1549+46.30, Cambridge Canal, Frenchman-Cambridge unit.	Rentlor Co., Inc., Grand Island, Nebr	119,393
2157	do	Apr. 22	Construction of earthwork and structures, Meeker Canal rehabilitation, Frenchman Cambridge Unit.	W. A. McNeel, Hershey, Nebr	35,150
2160	Columbia Basin, Washington	Apr. 30	Furnishing aluminum doors and windows for control Bay-R, Grand Coulee power plant.	General Bronze Corp., Garden City, N. Y	21,940
2162	Colorado Big Thompson, Colo	Apr. 16	Structural steel roof framing, crane girders and crane rails for Estes power plant.	Virginia Bridge Co., Denver, Colo	23,000
2169	Davis Dam, Ariz.-Nev	Apr. 30	Embedded metal work for two 22-foot by 19-foot high-head radial gates for Davis Dam project.	Schmitt Steel Co., Portland, Oreg	10,240
2194	Boulder Canyon-All-American Canal, Calif.	Apr. 30	50,000 barrels portland cement for Coachella Valley distribution system.	Monolith Portland Cement Co., Los Angeles, Calif.	187,500
R1-10	Deschutes, Oreg	Apr. 7	Four residences and garages, north unit, Main Canal	R. P. Syverson, Bend, Oreg	28,340
Read. 9 & 10.	Lewiston Orchards, Idaho	do	Asphalt coated welded pipe and couplings	Armco Drainage & Metal Products Co., Inc., Portland, Oreg.	266,886
R4-5	Paonia, Colo	Apr. 29	Construction of outside utilities for Government Camp at Paonia	Landon Construction Co., Casper, Wyo	14,872
R6 Bis.-5	Missouri Basin, N. Dak	Apr. 14	Construction of sewerage and water-distribution systems for Heart Butte Government camp.	Tri-State Excavating Co., Fargo, N. Dak	20,616
R6-Hur-1	Missouri Basin, S. Dak	do	Construction of outside utilities and erection of prefab. houses for temporary Government housing, Huron.	W. E. Bartholow & Son Const. Co., Huron, S. Dak.	14,793
R7-NP-1277	Missouri Basin, Wyo	Apr. 15	Transformers, circuit breakers, etc. for Lusk substation	General Electric Co., Denver, Colo	17,771

Construction and Supplies for Which Bids Will Be Requested During June and July

Project	Description of Work or Material
Boise, Idaho	Construction of transmission line from Anderson Ranch Dam to Mountain Home, Idaho.
Boulder Canyon, Ariz.-Nev	Generators for units A3 and A4, Hoover power plant.
	Power transformers for units A3 and A4, Hoover power plant.
	Turbines and governors for units A3 and A4, Hoover power plant.
Boulder Conyon-All-American Canal, Calif.	Construction of concrete pipelines and structures for unit No. 5 of Coachella Valley distribution system.
Central Valley, Calif	Grading and paving substation area and construction of railroad spur at Elverta substation.
	Construction of earthwork lining, and structures for 27 miles of Friant-Kern Canal, near Porterville, Calif.
	Construction of earthwork and structures for about 15 miles of Delta-Mendota canal near Patterson, Calif.
Colorado-Big Thompson, Colo	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on the Big Thompson River, 1 mile of tunnel, 12 concrete siphons, 1 steel siphon, and other structures, near Loveland, Colo.
Columbia Basin, Wash	Construction of earthwork and structures for 15.3 miles of the west canal near Ephrata, Wash.
	Construction of earthwork and structures for approximately 8.3 miles of Potholes East canal, near Norden, Wash.
Davis Dam, Ariz	Erection of river gaging station and cableway at Davis Dam.
Fort Peck, Mont	Construction of and furnishing materials for 2,000-kilovolt-ampere substation at Savage, Mont.
Kendrick, Wyo	Erecting foundation and 115-kilovolt and 57-kilovolt bus structures for Casper, Wyo., substation.
Missouri Basin, Wyo	Construction of 17 miles of 69-kilovolt wood-pole transmission line from Garland to Lovell, Wyo
	Construction of 40 miles of 115-kilovolt wood-pole transmission line from Lovell, Wyo. to Yellowtail, Mont.
Missouri Basin, Wyo	Elevators for Kortes Dam and power plant.
Missouri Basin, Kans	Construction of Cedar Bluff Dam.
Missouri Basin, Nebr	Construction of Bonny earthfill dam, on the South Fork of the Republican River, west of Hale, Colo.
	Construction of Superior-Courtland diversion dam, a 300-foot-long concrete overflow structure, on the Republican River, near Guide Rock, Nebr.
Missouri Basin, Wyo	Constructing and furnishing equipment for the Pine Bluffs Wyo., 6,000-kilovolt-ampere substation.
Missouri Basin, Wyo.-Nebr	Construction of 170 miles of 115-kilovolt wood-pole transmission line from Casper, Wyo., to Gering, Nebr.
Missouri Basin, Nebr	Constructing and furnishing equipment for the Alliance, Neb., 10,000-kilovolt-ampere substation.
Missouri Basin, S. Dak	Construction of about 3 miles of access road to Bixby Dam.
Missouri Basin, Mont	Construction of Canyon Ferry Dam and power plant, 15 miles northeast of Helena, Mont.
Missouri Basin, Nebr	Construction of telephone system from Cambridge, Nebr., to Medicine Creek dam site.
Missouri Basin, Colo	Construction of about 9 miles of access road at Bonny Dam, Yuma County, Colo.
Missouri Basin, Nebr	Furnishing and erecting 30 residences at Trenton Government Camp.
Paonia, Colo	Construction of Spring Creek Dam, an earthfill structure on east Muddy Creek, about 20 miles from Paonia, Colo.
Provo River, Utah	Construction of about 1 mile of 69-inch diameter steel or concrete pipe line for the Big Cottonwood section of the Salt Lake aqueduct.
Riverton, Wyo	Construction of earthwork and structures for portions of Wyoming Canal and Muddy Ridge Canal, including Muddy Ridge Tunnel and 1 lateral.
San Luis, Colo	Construction of Platoro Dam, an earthfill structure, on the Conejos River about 20 miles northeast of Paonia.

The "Reluctant Waterfall"

Photo by F. B. Pomeroy, Region 1

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JULY
1948

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How to Irrigate Higher Lands
by Henry H. Plumb

Siam—and Her Irrigation Works
by Paul Kheosiplard

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THE Reclamation ERA

Reclamation Place Names in This Issue

Letters to the Editor

Undue Credit to Riter

UNITED STATES DEPARTMENT OF THE INTERIOR,
BUREAU OF RECLAMATION,
BRANCH OF PROJECT PLANNING, HYDROLOGY DIVISION,
DENVER FEDERAL CENTER,
Denver, Colo., April 12, 1948.

GENTLEMEN: I feel that I have been given undue credit by having my name shown as joint author with Mr. E. W. Lane for the article entitled "The Life of Hoover Dam." Mr. Lane in cooperation with Mr. Whitney Borland of this office prepared the material which was used (with changes) in preparing the published article. After the material was prepared Mr. Maddock and I merely reviewed it and made a few suggestions to Mr. Lane. It seems to me, in fairness to Mr. Borland, that he should be given credit for joint authorship rather than me.

Sincerely yours,

JOHN R. RITER,
Chief, Hydrology Division.

A Contributor's Comment

P. O. Box 825,
Huron, S. Dak.

DEAR EDITOR: While I am writing this letter to have my address for the ERA changed, I also want to compliment you on the very fine paper you are putting out. I was not a regular reader of the ERA until I came with the Bureau of Reclamation in September 1946, but I can now state that it is a "must" here in the irrigation States, and that goes for not only Bureau employees, water users, and all other people intimately tied with irrigation and reclamation problems, but also for the majority of the citizens of these States.

South Dakota is not so definitely tied to irrigation, with respect to her agriculture, as most of the other Western States (that is, States beyond the western boundary line of South Dakota), but the irrigation and reclamation works proposed for that State definitely put it in the States vitally concerned with these matters.

Just a few words in regard to the articles that appear from time to time in the ERA, concerning reclamation matters in other countries, than the United States. I greatly enjoy them, and the one in the

(Continued on page 133)

Reclamation ERA

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

SEDIMENT SOLVERS: Members of the United States Navy ready to get to the bottom of the sedimentation problem by engaging in diving operations at Lake Mead. (See Life of Hoover Dam, April ERA and Science to Solve Silt Problem, June ERA.) Shown in this photo, prior to beginning operations, are left to right A. B. "Abbie" Holmes, C. M. N.; H. E. "Swede" Knudson, C. M. N.; J. D. M. "Pancho" Frietas, C. M. N.; and G. B. "Cookie" Labagnara, C. B. M. This photo taken by Wm. S. Russell, Region III, on May 1, 1948.

Left: Arrow points to close-up of jojoba berry from which oil is extracted. Below: The jojoba, a potential desert crop for irrigated crops deficient in water supply. The shrub in the picture is approximately 5 feet high. However, many jojobas grow as tall as 10 feet. They have a gray-green foliage and in the fall of the year the female bushes bear a crop of nutlike berries from which oil is extracted.

Jojoba —

POTENTIAL DESERT CROP

by Ralph O. Baird, Reclamation Economist, Project Planning, Phoenix, Ariz., Region 3

EDITOR'S NOTE: On and adjacent to most irrigation projects are areas either permanently or temporarily short of water required for full crop production. Many other areas are in a similar predicament. The discovery, the testing, and the pilot crop planting of new crops, native or from foreign lands, suitable for these areas, constitute one of the great and promising frontiers in the further development of the West. Some of the possible crops require but one or two supplemental irrigations during the season. The initial work with these new crops properly belongs to the United States Department of Agriculture and the State experiment stations. Pilot crop planting well may be the concern of industrial firms interested in special crop products which may be produced.

The development of water-stretching measures such as that accomplished by sprinkler irrigation, under test on many projects by the Bureau of Reclamation, may pave the way for a new future for lands which otherwise would remain desert. Possibly this article will stimulate interest in a new frontier of the West.

IN SOUTHERN ARIZONA where there seldom is enough water to go around, recent research has brought to light a new plant which may be an answer to the need for conserving soil moisture.

Known as the jojoba (*pronounced* hō-*hō*-bay), the plant thrives on much less water than is required by most other crops. The jojoba is a native of southern Arizona and northern Sonora, Mexico, and grows between the altitudes of sea level and 3,600 feet. Botanically, it is classified as *Simmondsia chinensis.*

The plant is striking in appearance, growing about 10 feet tall in the more favorable locations. It has gray-green, somewhat leathery, persistent foliage and in the fall of the year the female bushes bear a crop of brown nutlike berries. These berries contain about 50 percent of a readily extractable oily liquid. The residue after extraction of the oil is nutritious, being similar to cottonseed meal.

Primitive Indian tribes used the berries as food after roasting them to destroy the tannins that give the unroasted berry a bitter taste.

After the Spanish conquest and settlement, jojoba berries became an article of trade. The Spanish Dons found that the oil from these berries made an ideal hair dressing for their beards and mustaches, and they were the first jojoba oil extractors.

About 1929 Fred Gibson of the Boyce Thompson Arboretum at Superior, Ariz., and the author, ground up a few pounds of these berries and extracted the oil. This small sample of oil was sent to the University of Arizona for analysis and testing for possible uses. The sample was the forerunner of hundreds of samples that were later sent to public and private institutions and individuals for study.

The more intensive the studies became, the more valuable the product appeared, and numerous patents now have been issued to individuals and corporations on processes and products of the mustache wax.

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◀ Left to right: Jojoba nuts after hulling; jojoba meal; jojoba wax; jojoba wax united with sulphur; and hydrogenated jojoba.

As history has it, this is the way the jojoba bean's usefulness was first discovered by the white man. Drawing by Shirley Briggs. ▶

Briefly, this research showed that the oily extract of the jojoba seed is a liquid wax. It is stable and, therefore, will not become rancid; it is odorless and will remain so. Oddly enough, the wax is indigestible in the human alimentary tract. The wax will unite with sulphur to produce an intermediary of many uses. It will hydrogenate to produce a wax product that is exceeded in hardness only by the hardest natural wax, carnauba, and it can be used for almost all purposes for which carnauba is used or needed. It or its intermediate products can be added to other products to improve their desirable qualities.

A patent was granted to an oil company for the product made by adding a small amount of sulfonated jojoba wax to high pressure gear lubricant. This improved grease sustained the highest pressure recordable on the S. A. E. (Society of Automotive Engineers) pressure lubricant testing machine. The paint and varnish industry, the food industry (reducing diets), and many others have taken the jojoba nut to their research laboratories with gratifying results. The "catch" is that they cannot obtain the berries in sufficient quantities to put their new or improved products on the market.

To date the only jojoba berries that reach the trade are those that are collected from the wild plants. The Apache Indians of Arizona, the Papago and Yaqui of Sonora, collect a small tonnage each year for the market, but the demand, for research purposes alone, far exceeds the supply even at the current price of 20 cents per pound to the pickers.

The solution to this problem lies in the establishment of the plant under cultivation. Plantings would contain about 1,200 plants per acre which field tests indicate would yield about 1,200 pounds of fruit. At the current price of 20 cents per pound they would give a return on the investment exceeding that obtained from citrus or cotton at their present prices.

Test plantings have been made, the oldest at Riverside, Calif. Limited experience shows that best results have been obtained by planting the bushes in solid hedge rows with the rows about 12 feet apart. However, plantings to date can be considered only as pre-experimental. Commercial production economics, market outlets, long time price possibilities and other factors are obscure, and no land has yet been taken out of higher water requirement crops for planting to jojoba.

Water requirements are unusually low. From 1 to 2 acre-feet per year applied in good irrigations during the growing season are ample to produce a heavy crop. Experience also shows that better results are obtained if the seed for the planting comes from a more severe climate than the one in which the plantation is located. Only one insect pest is known to affect the crop—it is a micro-lepidoptera that feeds on the newly fertilized seed. However, this pest seems to be confined to elevation exceeding 2,500 feet.

Yes, the jojoba may offer new hope to southern Arizona which for the past several years has been turning land back to the desert as there is not enough water to go around. END

Letters to the Editor *(Continued from page 2 of cover)*

February issue, "Impressions of China," by Constantin P. Cristopoulos was not only very interesting and readable, but I think his "thinking and philosophy" are most worthy and should be spread around the world, and practiced. I would like his address so that I might write him.

Thanking you very much, I am
Sincerely yours,

RALPH E. JOHNSTON.

¶ Many thanks to writer ("Arizona—Great Outdoor Greenhouse" October 1947 RECLAMATION ERA) and reader Johnston. For the benefit of many other readers who were impressed with Dr. Christopoulos' articles, his address is: Dr. Constantin Christopoulos, 80 Pipinou, Athens, Greece. A recent letter from him indicated that he would greatly appreciate hearing from his friends.—Ed.

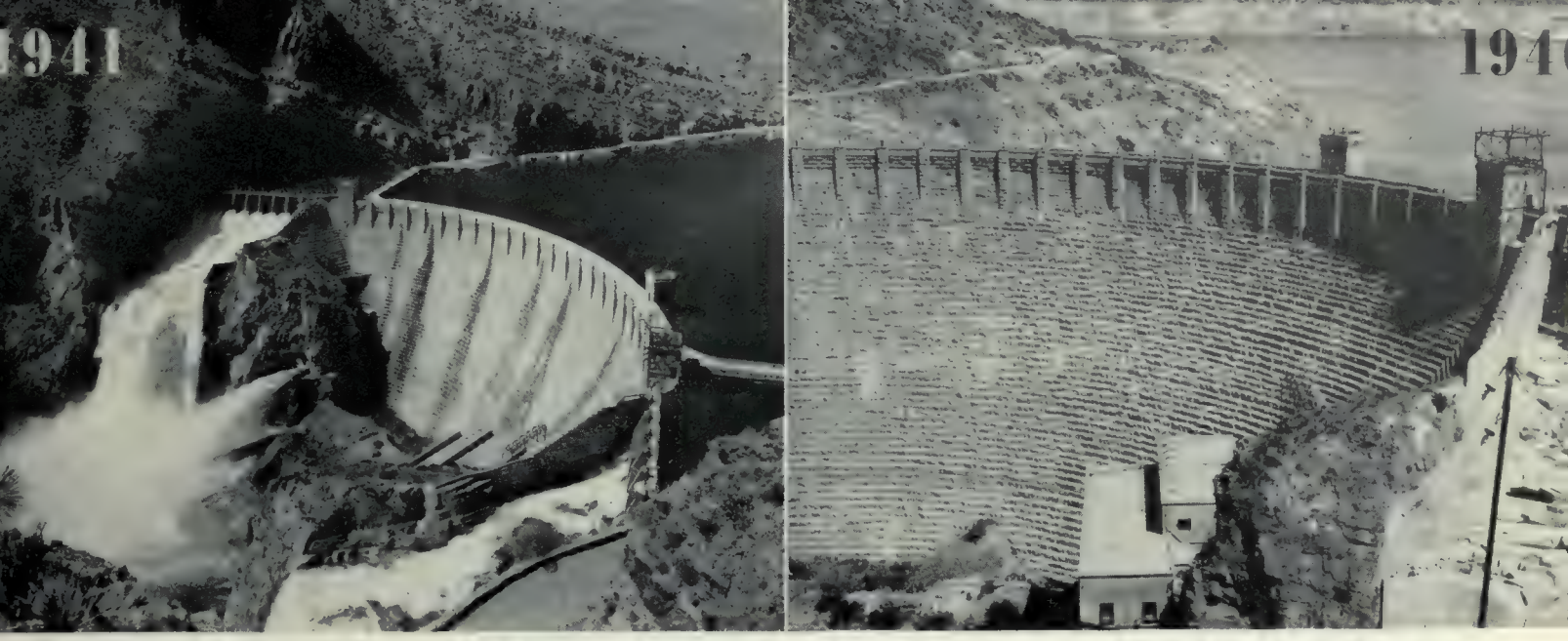
Bloody But Unbowed

TULELAKE, CALIFORNIA,
January 17, 1948.

DEAR EDITOR: I wish to make a correction on your January 1948 issue of the RECLAMATION ERA magazine. On the back cover (outside) you have printed two pictures of a well-known landmark of this community. One, an early picture of the lake as it appeared on June 9, 1905, the other, taken quite recently. The pictures were fine but the information misleading. You referred to the location as Tulelake, Oreg., this is wrong. Tulelake is in California, some 6 miles. The location of those pictures is some 14 miles south of the Oregon border.

Also you referred to the landmark in the background as "Bloody

(More letters on page 134)



The spillways of the Roosevelt Dam on the Salt River in Arizona roared with the overflow in the spring of 1941, before the Southwest had to face a water shortage. The same dam at right, in the fall of 1946, shows the tremendous difference in the water supply available to the Phoenix area's irrigation system.

ARE WE SHORT OF WATER? *(Part One)*

By LESTER VELIE

Reprinted from the May 15, 1948, issue of COLLIER'S through the courtesy of the editors and the special permission of the author, Associate Editor Lester Velie.

The water shortage is spreading like a creeping paralysis. We are using up our underground supply faster than nature can replenish it. The Middle West and industrial East are feeling the pinch but in the semiarid Southwest the trouble is coming to a head.

RICHARD HAMAN, A RANCHER, walked out of the Nevada State engineer's office recently with a legal claim to "full possession and rights thereof" of water in the clouds over his ranch. Moisture is scarce and he intends to milk the clouds whenever they appear, by dropping ice pellets into them, and he wants no ornery neighbor miles down the road getting possessive with the Haman air lake.

At Los Angeles, County Supervisor Raymond V. Darby asks the California legislature to put up $1,000,000 for ideas on how to get sweet water from the sea, cheap. The legislature appropriates no money, but ideas pour in from drought-conscious citizens anyway. One of them: Hoist the Palomar Observatory's $6,000,000 Big Eye out over the Pacific and harness the sun's rays for the heating and distillation of ocean water.

These characteristic American shenanigans provide the lighter side to a grim predicament. Large chunks of our country are running out of water. Drought is creating havoc in the Southwest. But drought is only partly to blame.

At Sacramento, Calif., a newspaper puts a black border on its weather news, in mourning over the situation. The item says, "No rain for 42 days. No rain today or tomorrow."

Townsfolk in Santa Barbara, forced to ration water, rename their city Sahara Barbara. The well-to-do import water by tank truck to save their lawns, and pay $40 per 2-hour wetting. A committee of vigilantes checks water meters for water hogging.

In California's fruitful Central Valley dairy farmers slaughter their cows, and cattlemen send steers out of the State by the thousand. No pasture. Beekeepers ship out their bees. No flowers.

But drought, even as war and pestilence, must pass. The kind of water shortage many communities face has nothing to do with drought. Far from passing, the shortage is, as one alarmed geologist described it, "spreading like a creeping paralysis." We are using up our underground water faster than nature can replenish it. Stored by years of rainfall it has become in some areas an exhausted resource. Chalk it up to overpumping. We are also running out of surface water—our rivers and lakes. Blame overpopulation.

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In the Southwest some experts are already reckoning the day when the last newcomer will cross the Rockies heading west, because there will no longer be enough water for all. Some engineers in Los Angeles have even set the dead line—1968. This is only 20 years away.

"As cities count time," one engineer said, "that's practically tomorrow."

In Arizona, and in California's Imperial Valley, the dead line has arrived.

Confronted with this nightmare of failing water California and Arizona are waging their own cold war over the Southwest's last big water hole, the Colorado River.

Surprised that water can be an exhausted resource? You shouldn't be. In the Texas Panhandle, as in California and Arizona, in the Dakota plains, and even in such eastern communities as Cincinnati, Louisville, and Brooklyn, men are learning a sobering lesson. Like oil and coal you can take water out of the ground faster than nature can put it back.

At Phoenix and Tucson in Arizona, and the irrigated lands around and about, men don't talk about war with Russia or the coming Presidential election. They've something more urgent on their minds—vanishing water. Irrigation is to dry Arizona's economy what lifeblood is to a human being. Two-thirds of this lifeblood comes from below the ground and a third from rains and rivers. So swiftly is Arizona's underground supply being drained away in some places by overpumping that A.N. Sayre, the Government's top expert in this field, says the State's plight will be desperate unless remedial measures are taken immediately. S. F. Turner, United States engineer at Tucson, said: "The situation is so critical it can no longer be solved solely by drilling new wells."

No wonder. In the Eloy area of Arizona's Pinal County, water is being mined 11 times faster than it can, naturally, be put back. In Maricopa County it is being taken out 18 times as fast, and for Arizona, as a whole, twice as fast. The result, Government geologists found in southern Arizona, has been that in several areas water levels have dropped 55 feet in 6 years.

The water table is not getting a chance to come back. As farm produce continues to bring premium prices, Arizona farmers get more land under irrigation and dig more wells. Some land has already returned to desert because of lack of water. Three hundred and fifty thousand acres, or about a third of all that State's arable land, face the same fate.

Said a frightened Arizonan:

"Unless the State finds new water sources, we won't only be shipping out bees and cattle like California. We'll be shipping out people."

Arizona's case is not unique.

In the Panhandle's high plains area, at Lubbock, Tex., farmers swamped local merchants this spring with demands for pumps, gobbling them up at the rate of 50 a day. It costs about $6,700 to dig a well in the outlying dry country, but with wheat bringing more than $2 a bushel farmers figured it was worth it. The result was that where only 1,100 wells tapped the underground pools of the Panhandle in the 1930's, 7,200 drain it now.

Yes, drain. Every year nature recharges, or stores, enough water in the area to cover 50,000 acres with a foot of water (50,000 acre-feet). But last year alone Panhandle farmers withdrew 750,000 acre-feet. That's 15 times as much as nature could put in! Down and down goes the water, and deeper and deeper go the wells. In 14 years, overpumping has lowered the water table 40 feet.

Some Texans have learned what prodigality of this sort leads to. When ground water gave out at Aspermont, an oil town 100 miles west of Fort Worth, a barrel of good drinking water brought in from neighboring towns could fetch more than a barrel of oil.

Other Americans are learning to import water, too . . .

(To be concluded next month)

More Letters *(Continued from p. 122)*

Point." This is also wrong, the name of this hill is "The Peninsula" and is so called by the people of this community, the local newspapers, and reclamation maps.

Yours truly,

BILL JONES,
Senior, Tulelake High School.

¶To alert high school student Jones, reluctant praise. A regrettable error, indeed, placing Tulelake in Oregon instead of California. Klamath project, in which is located the Tule Lake (two words, mind you, to make it more complicated) division, crosses the border—but the Klamath peninsula, well-known landmark, is about 8.5 airline miles inside the California border. Bloody Point, referred to in the caption, is the black jut of land in the bottom photo which can be barely discerned in the top photo due to the improvement of the land. Our experts say, "Ah erosion, ah, Soil Conservation Service . . ."—Ed.

Advice to the Land Lorn

8026 LAMBERT AVENUE,
DETROIT 13, MICH.,
February 1, 1948.

DEAR EDITOR: I should like to have you discuss in an early issue the following problem. How can a city-bred fellow start a career on the land? All of my life I have wanted to get out of the city. Living in a Metropolitan area, I have had little access to rural life. I can't even begin to meet the requirements for obtaining reclaimed land, i. e., I have had no experience in agricultural work. Although I have had college training, I did not study any agricultural sciences. My soul craves the life I have never known. My health is excellent. Please tell me the most logical step to take!

Very truly yours,

RICHARD LIPA.

¶ We understand and sympathize with Reader Lipa in his desire to own a farm of his own, a natural and deep-seated desire of many people. However, as he points out, he is not now eligible for participation in the Bureau of Reclamation's settlement program due to his total lack of farming experience. Irrigation farming, being a specialized type of agriculture, requires a background of experience and knowledge if a farmer is to make a living. This has been proved by scientific studies of those who have worked and lived on irrigation farms and the standards which are maintained for qualifying for a public land opening are for the protection of the potential reclamation farmer as well as for the protection of the investment of the United States Government in the reclamation program which makes possible the opening of reclaimed lands. We know of no substitute for farm experience other than actual work on a farm. Many young men have sought and obtained employment on farms to gain such experience, while they saved and planned for a farm of their own. Others have worked during their vacations, particularly college students, who added to their incomes as well as their knowledge of agriculture in this manner. However, Reader Lipa's problem is really outside the province of the Bureau of Reclamation and we referred his communication to the United States Department of Agriculture for more detailed information.—Ed.

NIOBRARA—the "Forgotten River"

Photo by R. A. Kneeshaw, region VII.

by CLYDE E. BURDICK, Area Engineer,
Ainsworth, Nebr., Region VII

THE NIOBRARA RIVER has often been referred to as the forgotten river in Nebraska. It extends from Niobrara, Nebr., to Lusk, Wyo., and flows through much of the sand-hills region nationally famous for its production of beef cattle.

Development of water—the State's greatest resource—in this area has lagged behind that of other basins in the State for various reasons. Historical records indicate that perhaps the first white men in this basin arrived about 1789, and traded with the Ponca Indians near the confluence of the Niobrara and Missouri Rivers. Sheldon's History of Nebraska speaks of a James Mackey, who reached the region of the sand-hill lakes in Cherry County in 1795–96, and continued north to the Niobrara River, which he followed down to the place where it joins the Missouri River. Mackey made a map of the area he had explored, which was published in Paris in 1802. On this map, in the vicinity of Long Pine Creek, is this inscription: *Mountains of sand, underlain by subterranean and invisible streams in the midst of which is a great canyon 250 feet across and 150 feet deep formed by the washing of the mountains.*

These early explorers were followed by men in search of new homes, who lived by hunting and trapping wild animals for food and furs. These were taken back to the settlements and traded, bringing good profits to the hunters. It took only a few years of systematic hunting to kill off the immense herds of buffalo, destroying the major food supply of the Indians, but making way for the large herds of cattle that were to come with the settlement of the country.

After the War between the States, herds of Longhorns came from Texas, traveling over the Chisholm trail and other routes to a new range, which has been described as *a great expanse of prairie, slightly rolling, spread out on every side as far as the eye could reach, most of it covered with a rich growth of grass.* Here and there were streams which were hidden in canyons or ravines where trees and shrubs were found, but until the edge of the canyon was reached, the entire country appeared to be a "Sea of Grass." Here the cattleman was King. Eventually the sand hills were opened for homesteading, and a claim shanty or soddy appeared on almost every square mile of the sand hills, but much of the land was of very little value except for grazing, and cattle-raising remained the major industry within the sand hills as it is today.

In the 1870's the Fremont, Elkhorn & Missouri Valley Railroad began building westward and large companies of settlers soon came to the eastern part of the basin, where land suitable for farming was available. This immigration continued throughout the 1880's until there was a claim shanty on almost every 160 acres of tillable land within the Basin. Rainfall was sufficient for a few short years, then in 1893, 1894, and 1895, drought came to Nebraska. Corn and small grain did well until July, then burned up. People left the basin by wagon loads. A good cow wouldn't bring $15, and shoats sold for 50 cents to $1. Not a great deal of stock was lost due to the droughts, as there had been moisture in the spring, and hay could be found in the sand-hill valleys, but the settlers endured many hardships.

In time, those who stayed were glad they had done so. As normal rainfall conditions returned, the labor of the farmer was rewarded by fair crops. Very slowly prosperity returned, but only through the strictest economy and most diligent labor were the debt-ridden people able to meet their obligations.

The railroad was completed and highways were built affording transportation for crops and livestock to their markets.

Farming became a general practice on the tillable lands north of the sand hills, and farmers, remembering the drought years of the 1890's, and the prolonged dry periods that occur almost annually during July and August, rec-

ognized the need for irrigation. Many small irrigation and power projects were developed, but most were abandoned after a few years of operation because of faulty construction, high operational costs, or other reasons. Water rights were granted and, even though some of the projects have been abandoned for years, their water rights still appear in the records.

The Mirage Flats project in western Nebraska was built by a group of farmers in the 1890's, but was abandoned after a few years when their wooden canal structures were lost by fire and windstorm, leaving the farmers unable to finance reconstruction. Another project was started to irrigate land in the vicinity of Johnstown and Ainsworth, but construction was never completed because of financial difficulties. These pioneers recognized the need for water to produce good crops, but were limited by their inability to raise funds. In addition, their projects were designed from sometimes inadequate surveys. No historical records of stream flow or weather were available; topographic maps did not exist. Soil surveys of those areas had not yet been made, and they did not have the benefit of the irrigation experience we have today.

In 1940, the Bureau of Reclamation was authorized to construct the Mirage Flats project to irrigate about 13,000 acres south of Hay Springs. That project is now completed and is in operation. In 1946, the Bureau was directed to make a comprehensive investigation of the entire Niobrara Basin to determine the possibilities of irrigation, power, flood control and other related features.

The first step in this investigation was to make an inventory of the potential projects within the Basin, assembling whatever data were immediately available to determine the feasibility of further detailed studies.

Soil survey maps of most of the basin, and weather reports were available. There were no topographic maps, and records of stream flows were limited to miscellaneous readings on tributaries and reports of a few recording stations maintained for short periods on the main stream.

Geological survey maps were limited, secondary roads were few, and at times the surveyors would have welcomed the use of the map made by Mr. Mackey back in 1795. However, additional information has been collected and a plan for the development of the potential projects is beginning to unfold.

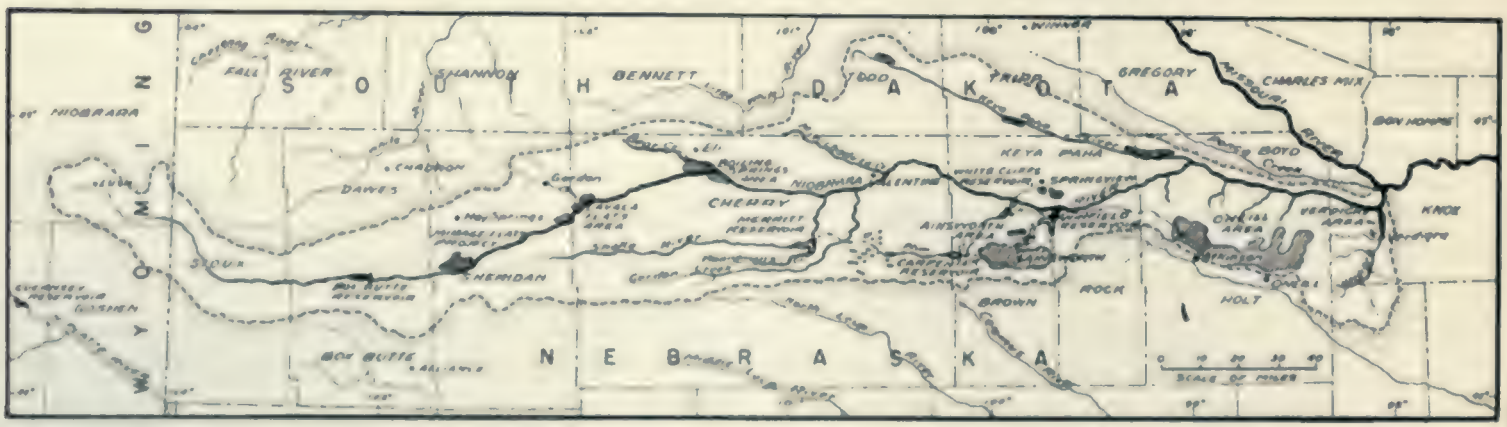
Preliminary appraisal or inventory of projects indicated that there are about 140,000 acres of land where soil topography, and drainage characteristics appeared to be favorable to irrigation and seemed worthy of further detailed studies. These are scattered areas and are mostly table lands which, in most cases, lie high above the Niobrara River and are bordered on one side by the sand hills.

From west to east, the projects under consideration are La Vaca Flats, south of Gordon, Nebr., Boiling Springs, south of Cody, Nebr., the Ainsworth table between Johnstown and Long Pine, Nebr., the O'Neill table extending from near Atkinson to O'Neill, Nebr., and scattered small areas along the Kaya Paha and Verdigre Rivers, and the Springview table near the town of Springview, Nebr.

The Ainsworth and O'Neill areas are the largest areas of potentially irrigable land within the basin, with approximately 45,000 acres at Ainsworth and 67,000 at O'Neill. Plans for the development of these areas call for the construction of a dam on the Snake River southwest of Valentine, which will divert water to a canal system through natural valleys to a point southwest of Johnstown, where a second dam would provide storage and regulations for the Ainsworth service area. Dams on Plum and Pine Creeks would capture the return flow, canal losses, and any water surplus to the needs of the Ainsworth area, and hold it for use on the O'Neill area. Preliminary studies indicate that the water supply available for these two areas is approximately 300,000 acre-feet per year. This does not include ground water supply which may be used to develop a portion of the areas, but for which sufficient information is not available at this time to estimate the amount that may be available.

Tentative plans for development of the smaller areas call for dams on tributaries of the Niobrara with short supply canals or pumping from the streams. Definite plans for these developments require further study of water supply, lands and engineering works. Small areas now under irrigation in the Niobrara Basin furnish ample proof of the feasibility of irrigation; lands that produce only fair crops at the best, depending upon normal rainfall, produce

(Continued on page 132)



Niobrara River Basin

First Water Reaches Columbia Basin Project

Left: Residents of Pasco and Pacific Northwest cities greet arrival of first water on Pasco unit of million-acre Columbia Basin project. Right: Three generations of the Gillum family are represented as the grandfather (William) right background, and his son (O. C.), at left, handle the first irrigation water to reach their privately owned Pasco lands, while 3-year-old Billy learns how it is done.

by GENE NICOLAI, Coulee Dam, Wash., Region I

In 1904, a virtually new organization then known as the United States Reclamation Service, made its first investigations of the possibilities of irrigating the Columbia Basin of eastern Washington with waters of the Columbia River.

On the morning of May 15, 1948, or just 44 years later, the vision of seeing the first Bureau of Reclamation water flowing to the dry lands in the Columbia Basin project became a reality.

The scene was near the banks of the mighty Columbia, about 15 miles northwest of the city of Pasco, and there was tightness in many a throat as a pump powered by Grand Coulee Dam electricity began pushing Columbia River water through a glistening discharge pipe, over a hill, and into the main lateral serving the 5,550-acre Pasco unit.

Men, women, children pushed anxiously to the canal's edge to get a first glimpse of the first water. Then, as it surged forth, its noise blended with the spontaneous roar created by the shouts and applause from the scores who crowded the canal banks.

Some of the oldsters who saw that first water knew of the delays, the dreams that had preceded the event they had assembled to celebrate at the invitation of the Pasco Chamber of Commerce and the South Columbia Basin irrigation district. They had lived through those years of indecision with unfaltering hope, but now they were too old to work the land.

But standing with them were younger men like O. C. Gillum, Howard Hales, Bill Lovercheck—veterans of World War II who will have farms in irrigation block No. 1, Columbia Basin project.

Fifty minutes after the first Pasco unit pump had started May 15, the water reached a turnout on Gillum's farm, about 2 miles away. Gillum and his family—and the crowd of well-wishers who had bounced along sagebrush-lined roads in their cars—were ready for it. Superior Court Judge B. B. Horrigan of Pasco, who earlier had given the all clear sign to Boy Scouts, who signaled the pumping station to begin operating, watched with others as Frank M. Lowden of Walla Walla opened the headgate.

These long-time project boosters, along with the new settlers, Pasco Chamber of Commerce representatives, the Columbia Basin Commission, and delegations from towns and cities of the Pacific Northwest, grinned elatedly as Gillum, a former Navy officer, grabbed his shovel and followed the water down his farm distribution basin.

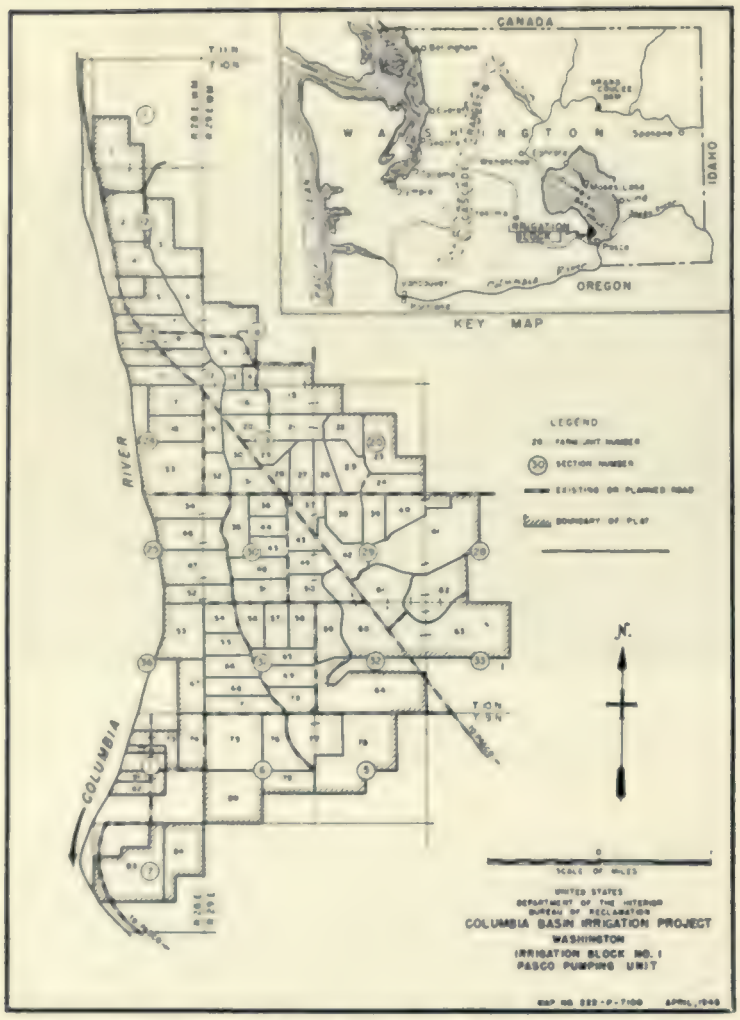
Three-year-old Billy Gillum, son of the veteran, was in the picture, too. His mother and his grandparents, Mr. and Mrs. W. F. Gillum, took off his shoes and stockings, rolled up his pants, and laughed as he waded in the water.

The crowd broke up and the Gillums began to get their first real taste of the responsibilities of irrigation farming.

"She's cutting through!" shouted a bystander.

O. C. Gillum, the one-time Indiana farm boy, and his father ran to stop leaks that were developing alongside the discarded railroad air hoses being used for spiles.

Gillum's 83-acre tract, which he will use chiefly to grow feed for his turkeys, is one of the 84 family-size farms which will be served by the Pasco pumping plant of the Bureau of Reclamation. Several fellow veterans also have holdings in the unit, but there are countless other veterans who would like to own farms, but who are employed at the nearby atomic-energy installations of the Hanford Works, marking time until larger acreages in the Basin are opened for settlement a few years hence.



This map shows how the 5,550-acre Pasco Unit of the Columbia Basin project has been divided into 84 farms averaging 64 acres each.

Bureau of Reclamation representatives and others who attended the Pasco event, pointed out that the opening of the 5,550-acre unit "is only the beginning."

Since nearly all the Pasco unit farms are in private ownership, the opportunity for acquiring a farm there is remote. The Bureau will have from 12 to 15 Pasco farms for sale, probably later this year. Veterans of World War II will receive preference when drawings are held. The Northern Pacific Railway will have about 30 farm units. It also will observe veteran preference, says P. D. Edgell, western land agent of the Northern Pacific, who has offices at 812 Smith Tower, Seattle.

But when selections finally are made by the Bureau and the railway, many hundreds of veterans in all parts of the United States still will remain on the waiting list.

The hope of these waiting veterans and others who seek farms in the million-acre project lies farther to the north, where a gigantic irrigation system is marching southward. The Bureau plans to have canals, siphons, tunnels, and other structures sufficiently advanced by 1951 so water will be available for 216,000 acres in 1952. Construction plans are geared to this goal.

In these first 216,000 acres will be many family-size farms, owned by the Government, which World War II veterans will have priority in acquiring. This is not homestead land—there is none in the entire project—but excess land bought by the Bureau and being held in readiness for veterans. It will not be sold to veterans for some years yet; not until delivery of water is assured for the block in which the property lies.

This land, like the hundreds of thousands of other acres that comprise the big Columbia Basin project, becomes highly productive under irrigation.

The irrigation system taking shape in the northerly part of the project ultimately will spread its canals to all parts of the million-acre expanse, making possible the creation of about 13,000 family-size farms.

When the water-distribution system is completed it will extend from the Grand Coulee Dam 140 miles southward to the vicinity of Pasco. It is because of this great distance that the Pasco unit was built first by the Bureau. When Columbia River water, pumped from Lake Roosevelt at Grand Coulee Dam, reaches the vicinity of Pasco, then the Pasco pumping plant probably will be dismantled and the lateral system served by water that has traveled more than 100 miles.

Development of the entire Basin has been the vision of many farsighted men like Judge Horrigan, who counseled the Pasco unit enthusiasts May 15 with these words:

"In many ways it is more important to dream than to fight against being mastered by dreams. The dream must come before the reality." END

National Conference on Land Use Policy

At a recent meeting in Omaha, Nebr., approximately 200 members of business and industry, representing 33 States, convened to sponsor a national coordinated policy for soil, water, forest, range, and wildlife.

E. J. Condon presided as chairman of the meeting, and among the outstanding speakers on the program were Fairfield Osborn, president of the Conservation Foundation and the New York Zoological Society; Kent Leavitt, president of the National Association of Soil Conservation Districts; Channing Cope, editor of the Atlanta Constitution; Zachary Taylor, editor of the Country Gentleman; Dr. H. A. Lyon, Detroit Board of Commerce and Agricultural Industrial Foundation, and many others.

The group consisted of persons associated with banks, public utilities, farm implement, life insurance, oil and metal products companies. In addition to these, various Government agencies were represented, including a small delegation from the Bureau of Reclamation.

As a result of the meeting the following conclusions were drawn:

- Business and industry are definitely concerned over the possibilities that the land resources of the Nation are being dissipated far too rapidly—and in the minds of these interests there exists a fear that unless the process of deterioration can be stopped industry and business will suffer great losses.
- That business and industry have awakened to the need, in this country, for a national land policy covering all levels of Government and community life.

Killing Weeds with 2,4-D

In the 3 years since its sensational introduction in 1944, the strange growth-regulating substance 2,4–D (the commonly accepted abbreviation of 2,4–dichlorophenoxyacetic acid) has become not only the most widely used chemical weed-killer in the United States, but the source of wholly new concepts of weed control that may markedly affect future American farm practice. This seems to be true even though all the facts about 2,4–D are not yet well known. 2,4–D is not a poison, in the ordinary sense, but a hormone-like material that causes serious disturbances in plants. Minute quantities in the plant tissues cause marked changed in the plant's form and functions. Some of these effects are beneficial, such as causing apples to cling to the bough until ripe. Others are highly detrimental or even lethal. In weed control the object is to use 2,4–D in such a way that it is lethal to weeds but harmless to other plants. Obviously this is a delicate operation and one that cannot be used carelessly or with a heavy hand. 2,4–D is a powerful weapon and must be used as such.

The Nature of 2,4–D

The action of 2,4–D on plants is much slower than that of other herbicides. First effects may not be apparent until a week after treatment and the plants may not die until 2 or 3 weeks, or more, thereafter. The most evident visible effects are bending and twisting of the stems, thickening and curling of the leaves, gradual change in color, usually to a yellow and finally a brown and eventually the death of the above-ground portion of the plant.

2,4–D acid itself is a white powder that does not dissolve easily in water. It is, therefore, usually changed to a salt or "ester," in which forms it can be dispersed in water and applied as a spray. Commercial 2,4–D weed-killers are soluble derivatives made with a stated percentage of pure 2,4–D acid.

Types of Commercial 2,4–D Weed Killers

Numerous preparations of 2,4–D are now on the market. These products, which vary in content of 2,4–D from about 10 to about 85 percent, are of three general types: (1) sodium and ammonium salts, (2) amine salts, and (3) esters. Although usually prepared as sprays they may be obtained in a form suitable for application as dust. In general, the relative effectiveness of the commercial preparations is directly proportional to the amount of 2,4–D contained. There are, however, certain differences in the rate of action of different types of 2,4–D, and in their final effects on various kinds of weed and crop plants.

OBSERVE THESE PRECAUTIONS

1. Protect sensitive plants from 2,4–D spray, dust, and fumes.
2. Use only minimum amount chemical needed for the job—don't overdose.
3. Check equipment carefully—faulty application is costly.
4. Have separate sprayer for 2,4–D, or cleanse carefully after use.
5. Use wisely and according to directions—2,4–D is not a cure-all.

A spraying machine in operation along one of the canals of the Black Canyon Division of the Boise project near Notus, Idaho, using a 2,4–D mixture of weed killer. ***Photo by Philip Merritt, Region I.***

Methods of Applying 2,4–D and Equipment Needed

The 2,4–D is applied most commonly as a very dilute spray solution in water, using a pressure sprayer. Satisfactory application can be made with a variety of spraying equipment ranging from small household and knapsack sprayers to large power-spraying units, and even airplanes for special cases. The best kind and size of sprayer depends largely upon the size of area to be sprayed. The essential requirement of spraying equipment is uniform coverage on the leaves of the plant with a minimum of run-off or wind drift. Spraying pressures between 30 and 100 pounds per square inch give best results for weed control. High pressures are unnecessary and wasteful and greatly increase the danger from drifting.

Especially adapted weed-spraying nozzles that deliver a fan-shaped spray give more uniform distribution of the material and usually better results than cone-shaped sprays. Several types of "fan" nozzles are available and can be obtained for nearly all sprayers.

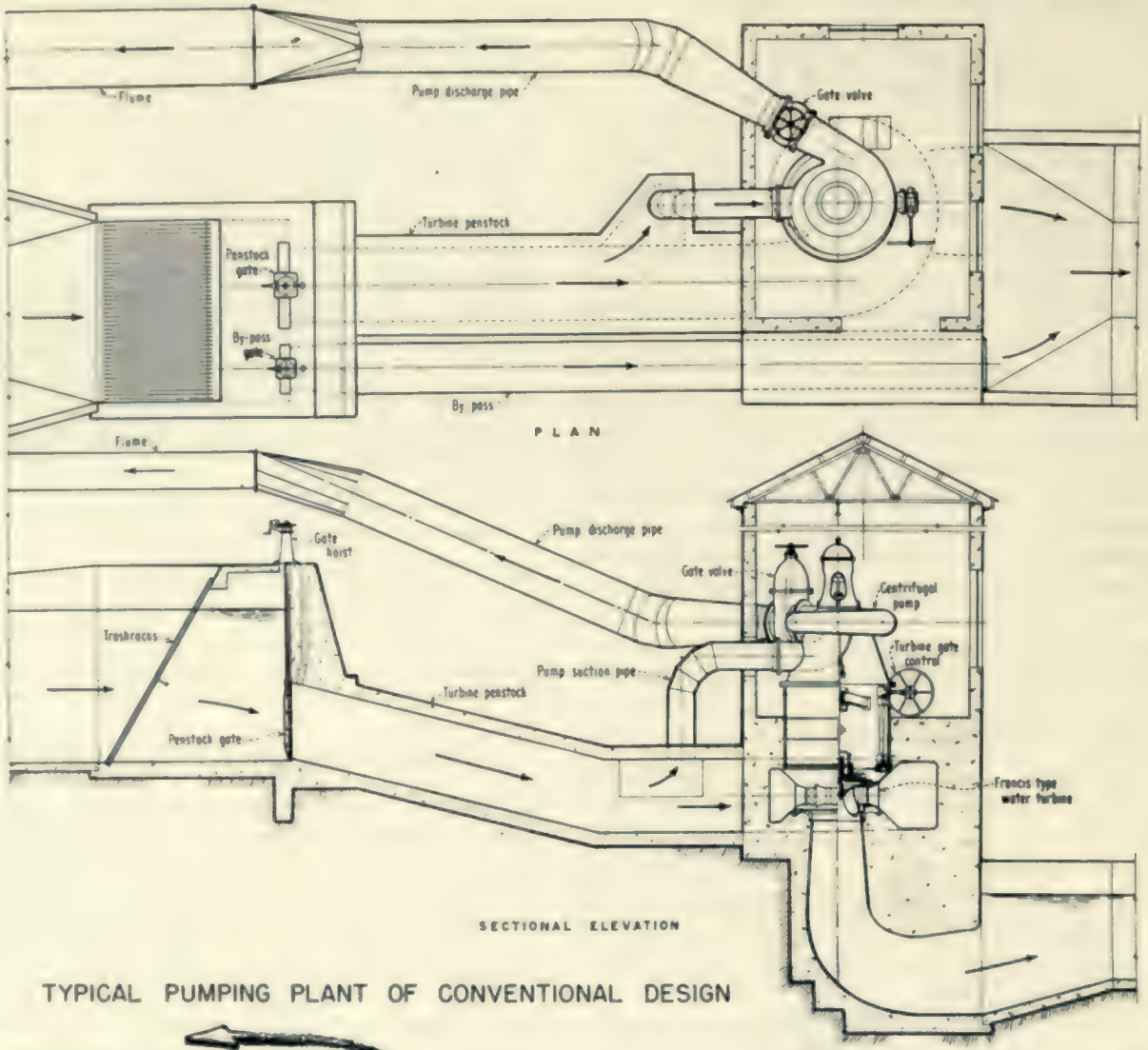
Time of Applying 2,4–D

Time of application is determined largely by the stage of growth of the weed and, in the case of selective sprays, by the stage of growth of the crop plants. In general, 2,4–D treatments have been most effective if applied when weeds are succulent, or at least in an active stage of growth.

Rate of Applying 2,4–D

Thre are two ways of expressing rate of application of 2,4–D—(1) in pounds of 2,4–D acid per acre and (2) in gallons of a certain percent solution per square rod. For large areas the "pounds of 2,4–D per acre" is usually more satisfactory. For small areas the other system is preferred.

(Continued on page 132)



TYPICAL PUMPING PLANT OF CONVENTIONAL DESIGN

How To Irriga

Turbine-Driven P

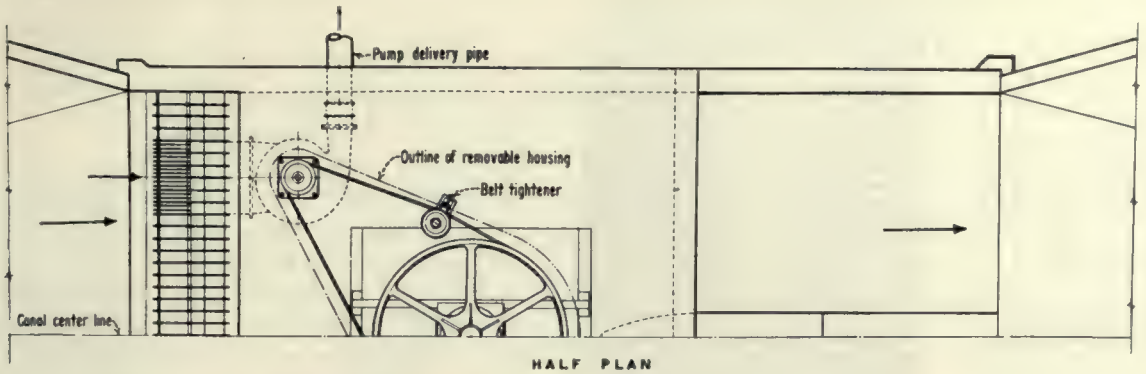
by HENRY H. PLUMB, Chief, Electrical Engineer

FROM the ancient man-powered waterwheel of Egypt to the modern pumping plant is a long series of steps in engineering evolution. However, each step was one in the right direction—toward successive improvement. Each proven design was an incentive for fresh study which brought forth even better devices with broader applications and increased efficiency.

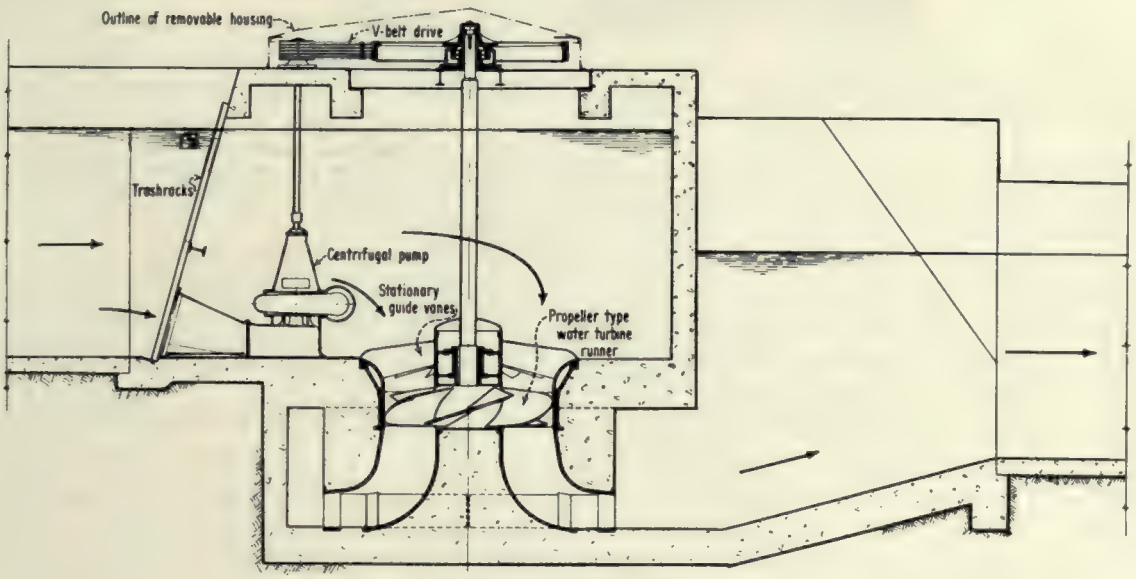
So it was with the conventional type pumping installations which harness waterpower at drops in irrigation canals for the purpose of lifting water from the canal to farmlands not accessible for watering by direct gravity flow. Such installations have proved to be both dependable and economical. However, other drops at sites near potentially irrigable land which lies above a canal have remained undeveloped. In this situation was a challenge for further improvement. The problem centered on the fact that the hydraulic head for the turbine was not considered high enough for practical development, or the initial cost of the installation would be too great.

For some of these neglected power drops, a new type pumping unit may make it possible for the first time to irrigate small isolated areas. Moreover, the proposed installation provides a number of advantages not possessed by the typical pumping units now in operation.

The new unit would utilize a V-belt drive arrangement between a centrifugal pump and hydraulic turbine, rather than the conventional direct-connected units. The turbine would be a high-speed propeller type rather than the conventional Francis or reaction type generally used. The propeller-type turbine is practical for heads as low as 10 feet, and pumping heads up to 100 feet or more could be used with a high-speed, single-stage pump. Thus a ratio



HALF PLAN



SECTION ON CANAL CENTER LINE

PROPOSED CANAL-DROP PUMPING PLANT

Higher Lands

rovide the Answer

, Branch of Design and Construction, Denver, Colo.

of 10 to 1 would be attainable between pumping lift and power drop.

The accompanying sketches compare the conventional direct-connected unit, with the proposed V-belted unit pumping plant. The proposed pump would be mounted in a submerged position in close proximity to the hydraulic turbine. The vertical shafts of the pump and turbine would be equipped with a grooved pulley on their upper ends. The two pulleys would be connected by multiple V-belts. The design shown would permit elimination of a superstructure with a substantial decrease in first cost resulting. A small steel housing over the pulleys would furnish adequate protection for the belts.

The V-belt drive permits both the hydraulic turbine and the centrifugal pump to be operated at their most efficient speeds. Further, the V-belt drive may make possible the higher pumping lifts of the water, by use of a high-speed, single-stage pump rather than a more expensive direct-connected multistage pump.

With the direct-connected type of unit, the turbine and pump designers are handicapped by the fact that the turbine and pump must rotate at the same speed, and consequently the selection of the turbine or pump, or both, has to be a poor compromise. Such a limitation results in higher initial costs, and also some sacrifice in efficiency. A gain of 5 or 6 percent may be realized in the efficiency of the belt-connected unit over the conventional direct-connected unit, if full advantage can be taken of the belted unit.

Multi-V-belts of standard manufacture are capable of transmitting up to 200 horsepower, and a 7 to 1 ratio in speed increase from turbine to pump can be utilized. For still greater horsepower, a gear drive may be used. The

Jesse W. Myer Retires After Serving Longest Term as Bureau Employee

Jesse W. Myer, oldest employee of the Bureau of Reclamation from the standpoint of service, retired optionally on June 30.

A farewell dinner honoring Mr. Myer was conducted by Regional Director K. F. Vernon and members of the region VI staff in Billings on May 12.

A graduate of Washington College of Law in Washington, D. C., Mr. Myer first became employed by the Department of the Interior in 1903. His initial assignment was with the Geological Survey, under which the Reclamation Service first operated. In 1905, after the Reclamation Service started operations as a separate unit of the Department of the Interior, Mr. Myer was transferred to serve with the agency. After being assigned for three years as a messenger, he was appointed to a clerk's position in 1907. After numerous promotions, he advanced to "senior clerk" in 1924 and to "principal clerk" the following year.

In 1945, he was made chief of the Office Services Division and later that year was designated a management analyst. In April 1947, he was transferred to region VI to act as organizations and methods examiner.

How to irrigate higher lands

(Continued from page 131)

cost of replacement for the V-belt is relatively small where overloading is avoided, as the normal operating life of this type belt is quite long. The belt efficiency is high. The new type unit would be capable of long operating periods without attention, except for necessary removal of trash. As the pump is submerged, it would be self-priming. Both the pump and turbine could be provided with water-lubricated guide bearings and the thrust bearings supporting the weight of the runners would be oil lubricated.

Not all of the desirable factors of available power, water, and head, together with irrigable bench lands reasonably close to the power site will be available in the maximum degree at every pumping plant site. Each development is an individual problem. Conventional, direct-connected pumping units will still be the logical choice for large-capacity plants where the pump can be operated at sufficient speed to lift the water to the desired elevation with acceptable efficiency and reasonable cost of construction. END

Killing Weeds with 2,4D

(Continued from page 129)

Actually the amount of solution per acre is important only in obtaining uniform coverage of the vegetation. It varies with the type and size of vegetation and the spray equipment used. The new "low-gallonage" equipment used to spray weeds in grain fields uses 5 gallons or less per acre of a concentrated solution. High-pressure equipment used for tall dense vegetation and woody plants may apply as much as 400 gallons per acre of low concentration. When using hand-operated sprayers, the rule is to apply sufficient solution to wet the leaves. The dosage can be adjusted by varying the concentration of 2,4–D in the spray solution to give the amount of acid desired. In low-volume spraying, dosage is varied by changing the nozzle size and the rate of forward travel of the spray equipment.

The complete bulletin from which the preceding information was extracted contains a more complete description of the types of commercial 2,4–D weed killers, the effect of 2,4–D on various plants, the rate of applying 2,4–D, lists of various weeds and crop plants, with their 'susceptibility" ratings, and other valuable information regarding this material.

For the complete version, ask for "Killing Weeds with 2,4–D" by L. W. Kephart and L. S. Evans, publication No. 97CC, January 1948, and send your request to: United States Department of Agriculture, Agricultural Research Administration, Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Cereal Crops and Diseases, Plant Industry Station, Beltsville, Maryland.

NIOBRARA—the "Forgotten River"

(Continued from page 126)

very favorably under irrigation. Under present conditions, the average yield of corn within the Basin is 14 bushels per acre, oats 20 bushels, barley 17 bushels, and alfalfa 1.3 tons per acre. With irrigation, substantial increases may be expected.

The total area of the Niobrara Basin is about 15,000 square miles. Of this, 1,394 square miles, or about 12 percent, is cultivated land. The balance is range land unsuited to general farming, but excellent for the production of livestock. Increased production due to irrigation would permit feeding of livestock in or near the area where they are raised. The population would increase to meet the new demands, better schools, churches, marketing and shipping facilities would come, and the economy of the entire Basin would be affected by the developments.

The Bureau's studies to date have dealt very briefly with the development of hydroelectric power. There are five small plants now operating, two on the main streams and three on tributaries.

The demand for power has increased, and the existing plants are inadequate to meet the increasing demands. There are many locations on the Niobrara River where additional power may be developed, and these are being given full consideration in the investigation.

With the development of the resources of the Niobrara Basin, this basin could take its place with other basins within the State in the production of food and would enjoy an economy and prosperity never before realized. END.

This article was adapted from a statement to the Nebraska Reclamation Association, at Kearney, Nebr., January 16, 1948, by Cylde E. Burdick.

Siam—and Her Irrigation Works

by Pard Kheosiplard

AUTHOR'S NOTE.—In May 1947, 29 Siamese engineers arrived in the United States to study irrigation construction and water distribution methods under direction of the Bureau of Reclamation. Three members of the party, Rung Khantong, Charin Atthayodhin, and myself, were assigned to work in the Bureau's Region V. During my period of study in the regional office at Amarillo, Tex., I was asked to write about the irrigation works in Siam. Unfortunately, I lacked exact data or figures for the subject required for carrying out this assignment at hand. So I had to make everything out of my own memory. Since the article is based on memory of the subject material, I hope the reader will bear in mind that should discrepancies appear in the manuscript I shall welcome criticism, for it is my intention to give the most accurate report possible under existing circumstances.—*Pard Kheosiplard.*

SIAM, an independent kingdom, is in southeastern Asia, not far above the equator; approximately north 6° and north 20° latitudes and between east 98° and east 106° longitudes. (See map above.)

The country has an area of about 220,000 square miles (only 47,000 square miles less than the State of Texas) and a population of approximately 18 million. Bangkok, the capital, has a population of about 650,000.

Geographically, the country may be divided in four natural regions. The northern section includes the drainage area of four rivers which unite at Nakorn Sawan (Pak Num Po) to form Chao Phya River. The four rivers are turbulent and shallow in the upper reaches, but slow moving and deep where they near the points of concurrence. This northern section is comprised of a series of parallel ranges, lying north and south, and rising from gently sloping acclivities in the south, to precipitous masses in the north. The areas watered by the rivers in the lower reaches are fertile and heavily populated. Villages are scattered along the banks of the rivers in the uplands. Much of the northern section

is covered with hardwood timber, including teak wood, one of the most famous species of the Far East. The average elevation of this section is about 1,050 feet above sea level, and the area is approximately 60,000 square miles.

The eastern section of Siam extends over approximately 70,000 square miles, including the drainage area of the Moon and She Rivers and their tributaries. It is generally a huge basin with a broad, high plain, about 200 to 300 feet above sea level, forming the bottom. The hill ranges partly surrounding this basin rise to between 1,000 and 2,000 feet above sea level. The plain is sandy and practically barren. It is subject to floods in the rainy season and to severe drought in the dry season, although it is an important rice growing and pasture area.

The central portion of Siam, including the drainage area of the Chao Phya, Suphan, Bang Pakong, Meklong and Prasak Rivers, extends over an estimated 50,000 square miles. This is the heart of the kingdom. It is a broad, low plain, rising from 10 to 60 feet above sea level. It is an alluvial area flanked by high mountains on the west, sloping to the sea in the south and around the inner Gulf of Siam. Most of Siam's population and wealth are in this central area.

The southern section, which includes the ax-handle part of the country extending into Malay Peninsula, includes an area of about 20,000 square miles. Para rubber and tin are the principal products. Elsewhere, in various parts of the kingdom, are minor sections occupied by fruit plantations, rice farms and forests. These isolated sections comprise another 20,000 square miles.

Siam has three seasons—cool, hot and rainy. Generally it is a monsoon climate. The cool season, beginning about the middle of October, is characterized by dry, cool north winds which continue to about the middle of February. Temperatures range from about 50° to 75° F. The hot season follows the cool season and continues to about the middle of May, during which time temperatures range from 80° to 100° F.

The rainy season extends from May to October. Because it is the most important season for Siam's agriculture, a brief explanation of it may be of interest. The southwest monsoon from the Bay of Bengal and the southeast monsoon from the China Sea, both moisture-laden, begin blowing into the country about May. The southwest monsoon, however, does not bring much precipitation to Siam, as its full force is broken by the Tenasserim Range on the west. The extent of the interference by the mountains is evidenced by the heavy rainfall in neighboring Burma, beyond the mountains, of more than 200 inches annually compared to that of about 50 inches at Bangkok and about 42 inches at Chieng-Mai (in the northern section).

The southeast monsoon from the China Sea is the most vital factor in Siam's agriculture. It approaches the southern part of the country in May, gradually shifts northward and passes over northernmost Siam in July. Then, in August, it shifts southward and again blows across the country until November. In this manner it spills its moisture over the entire area. Temperatures in the rainy season range from 65° at night to 80° F. in the daytime. Average rainfall during the growing season is about 41 inches.

Although rice is the principal food, Siam produces great quantities and varieties of food and fiber, including cotton, castor beans, soy beans and vegetables. The plains area produces rice, pepper, sugar cane, coconuts, bananas, mangoes, pineapples and similar crops.

As previously stated, Siam is supplied with considerable rainfall during the growing season—May to November. Rice, the country's staple crop and principal food supply, requires greater quantities of water than supplied by natural rainfall and greater still compared to other kinds of crops. Rainfall often is insufficient or it does not come at the time most needed for rice production. Droughts during the growing season are not uncommon.

Prior to the construction of modern irrigation works, rice culture, especially in the Central Plain area, depended on two natural means of water supply—rainfall and inundation of fields when the rivers overflowed their banks. Satisfactory crops were produced only when the following conditions prevailed:

- Satisfactory rainfall at the beginning of the season for preliminary agricultural operations.
- Sufficient rainfall to sprout the seed and mature it to a stage where it would not be harmed by inundation.
- Inundation by river overflow, but not so much that it would swamp the growing crops.
- Inundation to last the length of time necessary to bring the crop to full bearing.
- Decline of the rivers inundation in time to harvest the ripened crops.

When these conditions varied in any degree, the crops suffered in direct proportion. Seldom were all factors ideal for peak production. This was the situation that led to the construction of modern irrigation works.

About the turn of the present century, the Siamese Government negotiated with the Indian Government to acquire a specialist to explore the possibilities of irrigation in Siam. The Indian Government assigned Sir Thomas Ward to the job. Sir Thomas later submitted a report of his studies, including a general plan of projects, but because of an economic depression at the time, actual work on the system was delayed.

In 1913 the Siamese Government arranged with the Netherland Government for J. Homan Vanderheide, a Dutch irrigation specialist, then in Java, to make additional investigations and design certain projects. Mr. Vanderheide's conclusions followed the general pattern of those previously formulated by Sir Thomas. Construction of the first irrigation project was started in 1915, under direction of the newly formed Royal Irrigation Department. All irrigation systems in the country are designed for gravity flow. Pumping is not yet practical because of excessive power costs.

In order to conserve space, a description of Siam's irrigation works will be confined only to those in the Central Plain. Several irrigation projects are located on both sides of the Chao Phya and Suphan Rivers in the Central Plain area. These projects can be operated in conjunction with each other by a system of structures and canals. Part of the water requirements during the growing season is supplied by rainfall supplemented by irrigation.

The water elevation in the Chao Phya River during the growing season usually is sufficiently high to allow the river water to flow into the diversion canals of all projects. How-

ever, except during the growing season, the elevation is low, although there always is a minimum flow in the river. For example, at a point about three miles above the proposed dam site on the Chao Phya River (see map) the average maximum flow is approximately 211,000 cubic feet per second, and the average minimum flow is about 1,760 cubic feet per second. If the proposed diversion dam is constructed, an upstream reach of the river—approximately 75 miles—will serve as a reservoir. Moreover, the elevation of the water will be raised sufficiently to allow at least the minimum flow necessary for irrigation to be diverted into the irrigation projects during the dry season. Studies show that the increased water supply will permit production of two rice crops annually in favorable seasons. In any event, it will support and increase a diversified agriculture, with the production of other crops on rice land following the rice harvest.

Principal irrigation structures usually are of the diversion dam type (barrage or regulator) which serves to raise the water level sufficiently high to flow into head gates of diversion canals, and regulates the flow of the river. These structures usually are constructed in the low plain projects, and are concrete piers and abutments with steel sectional gates operated by winches mounted on steel or reinforced concrete superstructures. The average size of these is about 262 feet in length and about 26 feet high. The one proposed for construction on the Chao Phya River will be approximately 984 feet long, including log chute, navigation lock and fish ladder, and about 39 feet high.

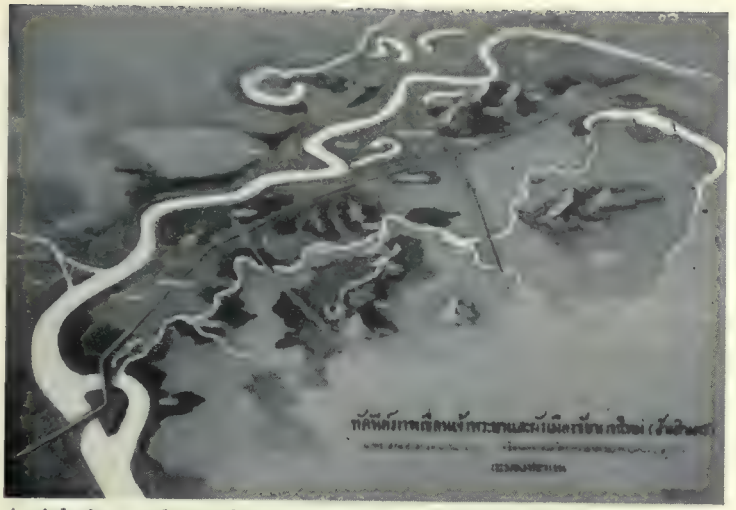
In the high plain area, main structures usually are of overflow dam type (weir) made of timber of concrete core wall and filled with impervious material such as clay, covered with rubble masonry.

Siam's farmers have grown rice successfully for generations on the same land without fertilizing the soil or rotating crops. This has been possible because each year the river water that was used to inundate the fields carried a great deal of silt. This silt fertilized the soil year by year, thus the soil could retain its fertility. Whether or not the use of modern irrigation works will upset this method of fertilization and require the use of commercial fertilizer is not yet clearly known.

However, about 20 years ago, the Siamese Government established experimental farms in various parts of the country to demonstrate the benefit of fertilizer as well as the diversified farming system. But the farmers, not unlike farmers in other parts of the world, are not easily nor quickly turned from their former practices, hence widespread use of fertilizers will come slowly, even in areas where it is needed greatly.

There are approximately 8,800,000 acres devoted to rice culture in Siam at present. After construction of the proposed Chao Rhya Dam, the acreage is expected to increase to more than 10,000,000 acres.

All costs of irrigation structures are financed by the Siamese Government. The fund is supplied from the country's general treasury. The operation and maintenance costs of the project are borne by the government from the same fund, which is maintained by all taxes, such as national, land, income, export, import and so forth. The fund



Aerial view and artist's conception of the proposed Chao Phya Dam site and Peace City on the Chao Phya River, approximately 100 miles upstream from Siam's capital city of Bangkok. Peace City, a proposed community, was so named because construction of the irrigation works would make the farmers of the area prosperous and happy.

also is used to finance all other developments throughout the country. There is no system for direct reimbursement at the present time.

The land tax is the same on all lands either in or outside irrigation projects. This is based on the theory that all developments in Siam are performed by the government for the benefit of the entire nation, and that developments which benefit any particular group of people will benefit all other groups either directly or indirectly. The irrigation policy of the government may be summarized as follows:

- Stabilization of the annual rice production.
- Improvement of inland trade.
- Increment of national prosperity through enhancement of land values.
- Increasing the ability of the farmers in paying land revenue.

The standard land unit of the country is 40 meters square or 1,600 square meters in area. This unit is called "rai." Approximately 2.5 rais are equal to one acre. Siamese in any part of the country may clear and develop vacant or undeveloped pieces of agricultural land and may possess this land which they acquire in this manner, according to legal requirements, such as successful development of the land within a certain period of time. All lands, except those owned by individuals, are considered as national lands and the government supervises them. Some lands are held for particular purposes such as forest reserves. There is no limitation on the amount of land that an individual may own regardless of whether the land is or is not irrigated. The average Siamese farmer owns from 12 to 20 acres.

I hope that I have been able to give to the readers a general picture of my country and her irrigation problems.

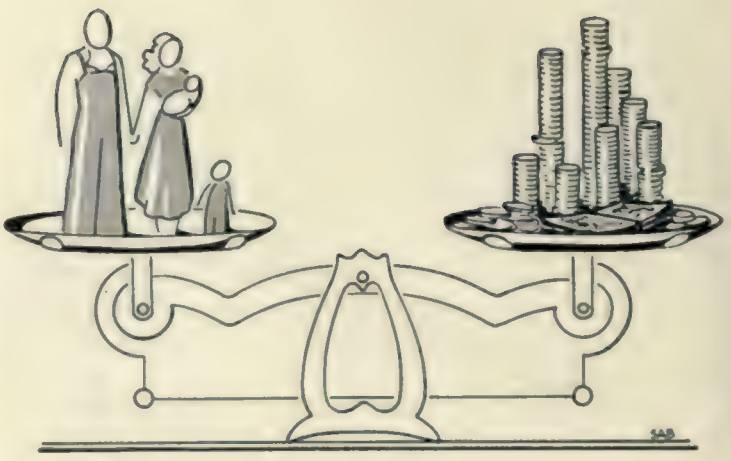
At this opportunity, I would like to express for all my countrymen our sincere appreciation to the Bureau of Reclamation in particular and American citizens generally for the generosity, courtesy and kindness extended to us during our stay in the United States. I also am personally grateful to the Bureau's officials and employees in region V for all the trouble they have taken in teaching me modern American irrigation methods.

END

VALUE for VALOR

Or . . . An analysis of the new wealth for Park County, Wyoming, in the persons of thirty-one veteran settlers

by JOHN K. BLACK, Engineer, Heart Mountain Division, Shoshone Project, Cody, Wyoming, Region VI



LIFE INSURANCE COMPANIES go to great lengths in determining the life expectancy of human beings. They have developed cold statistics showing how much time we can expect to have in this world and how much we can expect to earn in American dollars. The Bureau of Reclamation has devised impressive tables and other data to show how much wealth is brought to the West in the form of concrete, steel, electric energy, and man-hours of labor. It occurs to me that too little emphasis is placed on the value of the lives of the new settlers who are attracted to the irrigation projects which come into existence through Bureau of Reclamation development.

To begin such a study, it is of interest to consider some of the facts pertaining to the 31 young men who selected homesteads on the Heart Mountain Division of the Shoshone project in the State of Wyoming. These men by no means came here without "Purse or Script." Adding up the net worth figures for the 31 I find they total $256,870 for an average of $8,286.13. The highest amount shown is $33,000; the lowest $2,700. Only $2,500 was required by the examining board to meet the minimum requirement so far as capital is concerned. All of this wealth was brought here, together with a good name which each could use to borrow at least $3,500 from the Farm Home Administration, or a total of $98,500. Adding the sum of their net worths to the amount they could borrow makes $354,370 available for the lucky first 31 for first-year investments in modern farm homes, barns, farm shops, fences, machinery, and land improvements. Park County, Wyo., struck a gold mine in this drawing.

It is thrilling to read the letters of recommendations sent in from references used by these applicants. Most of them can be summed up in the words of one farmer who said this about the veteran whom he was recommending, "A very fine balanced young man, wife, and family. They will be an asset to any community, and we will miss them." Here is value this project and the surrounding towns will gain which cannot be measured in dollars and cents.

Three of the young men are college graduates and three others have had over three years of college training. The men brought an average of 10 years' farming experience. It is a known fact that life provides no substitute for experience when it measures out success. All of this training and experience is offered our communities on this project. Who knows but that the group includes future Congressmen, Senators, and it is certain that county commissioners, and community leaders in all fields of politics and society will be numbered among them.

These men bring another vital quality which many of us feel is slipping away and that is youth. The average age is 29½ years. The oldest is 45 years of age and the youngest is 21. It has been truly said that homesteading requires youth and determination first of all. These qualities abound among this group and great accomplishments can be expected from them.

They offer new experiences and possibly new enterprises for the communities. One veteran produced and sold 3,000 turkeys last year on a rented farm in Nebraska. He wants to investigate prospects for this business in Park County. Another produced ten tons of broom corn in eastern Nebraska worth $400 per ton. He wants to know whether it can be grown here. Two men are well established in the bee business and are looking for new fields of blossoms where the busy insects can find nectar which is now worth around 20 cents a pound. One has $48,000 worth of land-moving equipment and wants to do land leveling on a commercial basis. It is truly stated that "Nothing ventured, nothing gained," so we can look to the future with great anticipation of new developments from this year's homesteaders.

Perhaps the most valuable contribution these young men will make to our communities is the loyalty and love of the flag which they bring. Twenty-two of these veterans served their country in World War II in the Army; eight in the Navy, and one in the Marines. Four of these men were officers and 27 were enlisted men. Four were awarded the Purple Heart for wounds received in combat. One has the Distinguished Flying Cross and the Air Medal with Seven Oak Leaf Clusters.

When we consider this wealth concentrated at Heart Mountain we feel assured that this is truly a wonderful work. It should be a source of satisfaction to every person working for the Bureau of Reclamation to know that he is contributing to the success of this program. At the same time it is our solemn duty to do the best job possible of giving assistance and encouragement to these worthy veterans. END

A VETERAN'S VIEW

by RAY C. KING, Settler on Heart Mountain Division, Shoshone Project, Cody, Wyo., Region VI

Mr. and Mrs. Ray King, of Heart Mountain unit No. 31, planting and preparing ground for tiny plum trees which they hope some day will develop into a good-sized orchard. Note Mrs. King tying burlap covering around new tree to protect it from the rabbits who would otherwise enjoy it for an evening meal. *Photo by T. R. Broderick, Region VI.*

WE ARE A FORTUNATE FEW.

Upon discharge from the armed services we were afraid to peer too far into the future. We were ambitious but our problems seemed to multiply and multiply. Good jobs at high salaries were plentiful but most of us, having been born and reared on farms, could think of the future only in terms of owning a productive tract of land. However, after considering the current price of real estate, machinery and livestock, our savings of a few hundred dollars appeared very small indeed; and our prospects of owning our own farms, without burdening ourselves with an almost overwhelming debt, were far from encouraging.

Upon notification by the United States Bureau of Reclamation that 83 farm units in the Heart Mountain Division of the Shoshone project near Powell and Cody, Wyo., were open for homesteading, we filed application for one of them immediately. We hardly dared hope to meet the Bureau of Reclamation qualifications in all respects, draw a lucky priority number at a public drawing held in Powell and pass the scrutiny of a local board consisting of the late L. J. Windle, project superintendent, and two prominent local men.

When things had gone successfully this far, we at last began to realize that we weren't dreaming and that all we had to do to own a farm of our own, was to comply with the liberal homestead requirements.

We were farther surprised and pleased at being allotted two barracks and much useful equipment from a nearby former Jap internment camp.

A year has flashed by and we are far from prosperous. In fact, ours is probably the poorest community in the State of Wyoming.

Our first year's crops were failures. Cattle from the open range wandered on to many of the farm units and aided the homesteaders in harvesting their meager crops, since few of the units were properly fenced due to the scarcity of fencing material and lack of time.

Our crops this year are flourishing and our future appears brighter, despite the fact that those ever-hungry range cattle again trod our fence lines testing for weak spots. Already we are gaining, to a certain degree, that sense of security and independence which comes only to those who till the soil.

Most of us are living in our partly reconverted barracks which are far from modern and are lighting them by means of kerosene lamps or gasoline lanterns. Pack-rats from the desert often slink in to share our modest abodes and their rowdy romping in our attics at night causes many a sleepless hour.

A few of the settlers have been fortunate enough to obtain water by drilling but it is suitable for livestock only, due to the mineral content, and our water for domestic use is hauled for miles in cream-cans, barrels, tanks and whatever containers we may have.

Despite our many disappointing experiences of the past year, we are not discouraged. We know that ours is a workable, responsive soil and that nature, due to the existing desert conditions in the valley, has been unable to grow the vegetation necessary for building up organic matter in the soil. We are determined to give nature a helping hand by plowing under legumes and other green-manure crops. Thus, in a few years, we expect to accomplish the work at which she, unaided, has so miserably failed.

We like the people of Wyoming. They are friendly, frank and unassuming, traits of a truly agricultural community.

We now feel that we are full-fledged citizens of Wyoming and as such expect to take active interest in all community, county and State affairs. We expect to conduct ourselves in such a manner that we shall be considered a credit to the community and not mere riff-raff that has drifted in from other States.

We are men of vision. When we gaze across these barren, desert tracts, studded with sage and homesteaders shacks, we are looking far into the future, and visualize waving fields of grain and alfalfa, green pastures and modern homes of a prosperous and happy farm folk.

Yes, with our feet planted firmly on Wyoming soil, we throw back our shoulders, breathe deeply of her invigorating air, gaze at her beautiful mountains and are thankful to the depths of our hearts that we live in the greatest, most generous democracy in all the world. END

History of the Bureau of Reclamation's Regular Annual Appropriation Act, 1949 (*Exclusive of Trust Funds*)

State	Project	Allowed by the Bureau of the Budget	As reported by comm. (Rpt. No. 2038 & passed by House (H. R. 6705, 5-27-48)	As reported by Senate committee (Rpt. No. 1029) and passed by Senate	As recommended by conference committee	Appropriation Act 1949
Reclamation fund, special fund						
Salaries and expenses		$5,000,000	$3,161,472	$4,000,000	$3,600,000	
General investigations		5,450,000	3,000,000	4,000,000	3,500,000	
Construction						
California	Santa Barbara-Cachuma Unit	3,000,000	1,000,000	2,700,000	1,000,000	
Colorado	Paonia	471,000	471,000	471,000	471,000	
Idaho	Boise:					
	Payette Division	1,700,000	1,400,000	1,650,000	1,525,000	
	Anderson Ranch	5,800,000	5,100,000	5,100,000	5,100,000	
	Lewiston Orchards	1,136,000	1,136,000	1,136,000	1,136,000	
Montana	Sun River	47,000	45,000	45,000	45,000	
New Mexico	Tucumcari	1,549,000	1,200,000	1,398,000	1,243,000	
New Mexico-Texas	Rio Grande	100,000	25,970	90,000	57,585	
Oklahoma	W. C. Austin	320,000	320,000	320,000	320,000	
Oregon	Deschutes	230,000	580,000	580,000	580,000	
	Owyhee	150,000	150,000	150,000	150,000	
Utah	Ogden River	34,000	34,000	34,000	34,000	
	Provo River	2,200,000	1,800,000	1,980,000	1,980,000	
Washington	Yakima—Roza Division	1,497,000	1,250,000	1,347,300	1,200,650	
Wyoming	Kendrick					
	Riverton	2,011,500	1,750,000	1,810,350	1,780,175	
	Shoshone	430,000	430,000	430,000	430,000	
Subtotal, Reclamation Fund, Construction		20,664,500	16,691,970	19,229,650	17,200,810	
Operation and Maintenance:						
Arizona-California	Parker Dam Power—Power Revenues	2,730,000	2,312,880	2,645,380	2,645,380	
	Yuma:					
	Direct Appropriation	130,000	116,000	116,000	116,000	
	Power Revenues	32,000	32,000	32,000	32,000	
	Yuma (Improvements and Betterments)—Power Revenues	78,000	78,000	78,000	78,000	
California	Central Valley:					
	Direct Appropriation	300,000	210,875	250,000	230,437	
	Power Revenues	800,000	768,800	860,000	814,400	
Colorado	Colorado-Big Thompson—Power Revenues	167,500	150,000	150,000	150,000	
Idaho	Boise—Direct Appropriation	250,000	210,000	230,000	220,000	
	Minidoka:					
	Direct Appropriation	38,000	30,000	30,000	30,000	
	Power Revenues	619,000	395,000	500,000	447,500	
Nebraska-Wyoming	North Platte—Power Revenues	336,000	165,000	186,000	175,500	
New Mexico-Texas	Rio Grande—Power Revenues	355,000	235,000	235,000	235,000	
Oregon	Deschutes—Direct Appropriation	150,000	85,000	117,500	101,250	
	Owyhee—Direct Appropriation	325,000	285,000	300,000	292,500	
Oregon-California	Klamath—Direct Appropriation	238,000	210,000	224,000	217,000	
Washington	Columbia Basin—Power Revenues	1,780,000	1,600,000	1,690,000	1,645,000	
	Yakima:					
	Direct Appropriation	360,000	330,000	345,000	337,500	
	Power Revenues	25,000	25,000	25,000	25,000	
Wyoming	Kendrick—Power Revenues	225,000	200,000	212,500	206,250	
	Riverton:					
	Direct Appropriation	98,800	92,000	95,400	93,700	
	Power Revenues	60,850	56,000	58,425	57,212	
	Shoshone:					
	Direct Appropriation	97,700	60,700	84,700	77,200	
	Power Revenues	133,300	95,300	114,300	104,800	
Subtotal, operation and maintenance—direct appropriation (irrigation)		1,987,500	1,638,575	1,792,600	1,715,587	
Subtotal, operation and maintenance—power revenues		7,191,650	6,112,980	6,786,605	6,616,042	
Total, operating and maintenance		9,179,150	7,751,555	8,579,205	8,331,629	
Rehabilitation and betterments of existing projects:						
Arizona	Salt River	556,500				
	Yuma	500,000				
California	Orland	50,000				
Montana	Bitterroot	40,000				
	Milk River	100,500				
Nebraska	North Platte	750,000				
Nevada	Humboldt	225,000				
New Mexico	Carlsbad	400,000				
Utah	Hyrum	48,000				
Washington	Yakima	151,000				
Subtotal, rehabilitation and betterments of existing projects		2,824,000		1,500,000	1,500,000	
Total, reclamation funds, special fund (includes appropriations from power revenues)		43,017,650	30,604,997	37,308,855	34,132,439	
General fund						
Construction						
Arizona	Gila	3,000,000	2,240,000	2,700,000	2,470,000	
	Yuma—Reservation Division					
Arizona-Nevada	Davis Dam	25,427,000	18,000,000	22,884,300	22,125,000	
Arizona-California	Parker Dam Power	290,000	190,000	234,000	212,000	
California	Central Valley	47,186,000	40,000,000	42,067,000	41,458,000	
	Kern River	50,000	40,000	45,000	42,500	
Colorado	Colorado-Big Thompson	23,000,000	19,750,000	20,700,000	20,225,000	
Montana	Hungry Horse	9,850,000	8,100,000	15,115,500	14,611,750	
Washington	Columbia Basin	50,000,000	45,312,000	45,312,000	45,312,000	
Subtotal		159,774,000	133,632,400	149,458,300	146,357,250	

(No change)

State	Project	Allowed by the Bureau of the Budget	As reported by comm. (Rpt. No. 2038) & passed by House (H. R. 6705, 5-27-48)	As reported by Senate committee (Rpt. No. 1609) and passed by Senate	As recommended by conference committee	Appropriation Act 1949 [1]
General fund—Continued						
Special Acts:						
Montana	Fort Peck	$2,200,000	$990,000	$1,980,000	$990,000	
Various	Missouri River Basin	63,900,000	52,767,500	56,275,800	54,786,650	
	Advances to Colorado River Dam Fund:					
Arizona-Nevada	Boulder Canyon	1,920,000	1,600,000	1,728,000	1,700,000	
California	All-American Canal	4,484,000	4,000,000	4,242,000	4,000,000	
Arizona-California	Colorado River Front Work and Levee System	1,160,000	1,050,000	1,050,000	1,050,000	
Total, general fund, construction		232,437,000	194,039,900	214,734,000	208,883,700	
Alaskan investigations		150,000	150,000		150,000	
Operation and maintenance: California	All-American Canal	216,000				
Protection and maintenance of transferred property						
Other special funds:						
Colorado River development fund		500,000	500,000	900,000	900,000	
Colorado River Dam fund:						
Arizona-Nevada	Boulder Canyon, O. & M	1,637,000	1,500,000	1,500,000	1,500,000	
Subtotal		2,137,000	2,000,000	2,400,000	2,400,000	
Total, general and special funds (includes appropriation from power revenues)		277,957,650	226,794,897	254,442,855	245,566,139	
Permanent appropriations:						
Repayment of advances from the Treasury (All-American Canal project)		125,000	125,000	125,000	125,000	
Fort Peck continuing fund		250,000	250,000	250,000	250,000	
Payments to States of Arizona and Nevada		600,000	600,000	600,000	600,000	
Repayment of advances from the Treasury, with interest (Boulder Canyon project)		5,000,000	5,000,000	5,000,000	5,000,000	
Total, permanent appropriations		5,975,000	5,975,000	5,975,000	5,975,000	
Grand total, all accounts (includes appropriation from power revenues)		283,932,650	232,769,897	260,417,855	251,451,139	

[1] No change.

Congressional Action on Funds—Fiscal Year 1949

For the fiscal year 1949 which begins July 1, 1948, and extends to June 30, 1949, the President of the United States transmitted to the Congress for its consideration appropriation estimates for the Bureau of Reclamation totaling $277,957,650; of this amount $255,925,500 was for continuation of construction of various projects in the 17 Western States and the remaining amount of $22,032,150 was for general supervision, investigations of future projects, and operation and maintenance of all completed projects not turned over to the water users.

Extensive hearings were held by the Subcommittee for Interior of the Committee on Appropriations for the House of Representatives. These hearings began on March 25 and extended through April 30 for a total of 36 sessions. Every phase of the Reclamation activities was explored in detail in the printed hearings embodying 1,911 pages. On May 26 the full Appropriation Committee reported the Interior Department appropriation bill to the House and included $226,794,897 for the Bureau of Reclamation of which $210,731,870 was for construction.

The House committee in reporting out the bill provided funds for all projects included in the President's budget, and the amounts averaged 18.5 percent less than the amount of the estimate. In addition to the dollar appropriations, the House bill included a number of language provisions.

The bill passed the House on May 27 and hearings began before the Senate Subcommittee on Interior Appropriations the following week. The Bureau of Reclamation appeared on June 3 and 4, night hearings being held on both nights. The Senate bill was reported on June 12 and was passed by the Senate on June 14. As passed by the Senate the bill included $254,442,855 for the Bureau of Reclamation, of which $235,463,650 was for construction of projects. The bill as passed by the Senate was without most of the language provisions that had been included in the House bill.

Conferees on the bill met beginning Tuesday, June 15, and reported the results of their efforts to compromise between the House and the Senate on June 17th. The bill as finally reported by the conferees and accepted by both Houses which will become law for the fiscal year 1949 contains $245,566,139 for the Bureau of Reclamation of which $277,584,510 is for construction. The final bill modified language provisions that had been originally included in the House bill.

The bill as finally passed requires the Commissioner, Assistant Commissioners, and all Regional Directors to have at least 5 years of engineering and administrative experience after January 31, 1949. This affects the tenure of office of Commissioner Michael W. Straus and Regional Director Richard L. Boke of Sacramento, Calif.

The bill also includes restrictions on personnel, but modified somewhat from the original House action; requires the absorption of construction contract holdbacks payable in future years; permits the use of force account employees at a cost not exceeding 8 percent of the construction appropriation for any project; provides for investigation work in Alaska as a basis for legislation; provides for payments to school districts for instruction of dependents of employees of the Bureau and contractors engaged on construction of projects; authorizes work on rehabilitation and betterment of existing projects totaling $150,000,000; and provides for transfers to the Bureau of Reclamation of miscellaneous Government projects now in the custody of the War Assets Administration.

The measure also authorized $126,000 of available funds to complete the Buford Trenton projects in North Dakota.

The Second Deficiency Act for 1948, passed in the closing hours of Congress, includes $1,113,000 for the Bureau of Reclamation for the Boulder Canyon, Preston Bench, and Fort Sumner projects, as well as $2,000,000 for the Department of the Interior to overcome damage to Department property occasioned by floods in the Columbia Basin area.

News Round-Up

International Congress on Large Dams Meets

The third International Congress on Large Dams met at Stockholm, Sweden, June 10–17 with Gail A. Hathaway, Special Assistant to the Chief of Engineers, Corps of Engineers, Department of the Army, presiding as Chairman.

Walker R. Young, retiring Chief Engineer of the Bureau of Reclamation and Joel D. Justin, consulting engineer of Cornell University, served as Vice Chairman. Other distinguished members of the delegation included:

E. Robert de Luccia, Chief, Bureau of Power, Federal Power Commission.

B. F. Jakobsen, Chief, Plans and Specifications Section, South Pacific Division, Corps of Engineers, Department of the Army.

T. A. Middlebrooks, Chief, Soils Branch, Office of Chief of Engineers, Corps of Engineers, Department of the Army.

Clarence Rawhouser, Engineer, Dams Division, Bureau of Reclamation, Department of the Interior.

Dr. Karl Terzaghi, consulting engineer, Graduate School, Harvard University.

Carl P. Vetter, Chief, Office of River Control of the Colorado River, Bureau of Reclamation, Department of the Interior.

As a report on the Conference was not available at the time this issue went to press, a resumé of the proceedings will be published in our next issue.

Kansas Dedicates Its First Big Multiple-Purpose Dam and Reservoir

The huge Kanopolis Dam on the Smoky Hill River, located 25 miles southwest of Salina, Kans., has been completed and was dedicated on May 31, 1948. This is the first dam of the comprehensive Missouri River Basin plan of development to be completed in the lower Missouri River Basin, and it is the first major multiple-purpose dam constructed in the entire State of Kansas.

During the dedication ceremonies, Gov. Frank Carlson of Kansas accepted the physical structure in behalf of the "people of Kansas" from Maj. Gen. Lewis A. Pick, Missouri River Division Engineer. General Pick is coauthor of the Pick-Sloan plan for development of water resources in the Missouri River Basin which extends from the mountains in Montana to St. Louis, Mo., including all or parts of 10 States.

The Kansas State Highway Commission reported that about 35,000 people attended the big celebration at Kanopolis Dam. A State-wide radio broadcast was made of the ceremonies, and there were boat races on the reservoir. Region VII Director, A. A. Batson, District Engineer H. E. Robinson of the Kansas Basin District, and Engineer A. C. Brady of the Bureau of Reclamation attended the gala celebration.

The 3-mile long Kanopolis Dam, constructed by the Corps of Engineers of the Department of the Army, is 131 feet high, and provides a maximum storage of 450,000 acre-feet. It is a multiple-purpose reservoir for flood control and water conservation, and offers attractive possibilities for recreational use, such as boating, fishing, swimming, and other outdoor sports.

There is a possibility of irrigating some 40,000 acres of valley land between Kanopolis Dam and Salina, Kans., by use of waters regulated at the reservoir which has been authorized by the Congress as part of the plan for development of the Missouri River Basin.

Railroad Men Meet at Billings

Representatives of the various railroads operating in Region VI met with Bureau officials recently in Billings, Mont., in order to gain better understanding of the immediate Missouri Basin project.

Among those present were John W. Haw and L. A. MacDonald of the Northern Pacific Railway; L. H. Robbins and G. A. Dyke of the Chicago, Milwaukee, St. Paul & Pacific Railroad; E. M. Gregory and C. E. Jarrett of the Great Northern Railway; A. P. Simon and D. C. McLeod of the Soo Line; and Val Kuska of the Chicago, Burlington & Quincy Railroad.

The railroad men stressed the need for speeding up construction of the Missouri Basin to show the people of the Missouri Basin States that the Bureau is actively engaged in the construction of the project. Too many persons, it was asserted, erroneously believe that the development is still in the "paper plan" stage, to be built sometime in the far distant future. The railroad representatives asked that the people of the country be informed of the benefits to be derived throughout the country from the project and urged the lessening of repayment obligation to the water users in recognition of the national importance of irrigation during a period when food and fibre supplies are short.

Three Die in Tucumcari Cave-In

Construction Engineer William Q. Reeves, Field Engineer George R. Fulton, and Dragline Operator Carl Berg, of the Bureau of Reclamation's Tucumcari project in New Mexico, lost their lives following a cave-in of earth overlying the Conchas Dam irrigation tunnel No. 5 at the south edge of Tucumcari on April 30.

The men were investigating a cave-in which had occurred the week preceeding. The earlier cave-in had been the subject of continuous probing by Bureau engineers and geologists to determine its cause up to the time of the fatal accident.

U. S. GOVERNMENT PRINTING OFFICE: 1948

NOTES FOR CONTRACTORS

Contracts Awarded During May 1948

	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
[illegible]	Colorado-Big Thompson, Colo.	May 13	Switchboards for Estes power plant, schedule 1	Westinghouse Electric Corp., Denver, Colo.	$77,021
[illegible]	do	May 7	Distribution switchboards and battery chargers for Estes power plant, schedule 2.	Wolfe and Mann Manufacturing Co., Baltimore, Md.	34,940
[illegible]	Columbia Basin, Wash.	May 24	Three circuit breakers and 6 current transformers for Grand Coulee switchyards, schedules 1A and 3A.	General Electric Co., Denver, Colo.	463,560
[illegible]	Hungry Horse, Mont.	May 28	Furnishing and installing four 75,000 kilovolt-ampere generators for Hungry Horse power plant.	do	4,414,000
[illegible]	do	May 19	Four 105,000-horsepower hydraulic turbines for Hungry Horse power plant, schedule 1.	Allis-Chamlers Manufacturing Co., Denver, Colo.	2,150,000
[illegible]	Fort Peck, Mont.	May 14	Control board for Williston substation, schedule 1	Westinghouse Electric Corp., Denver, Colo.	20,918
[illegible]	Davis Dam, Ariz.-Nev.	May 5	Current transformers for Cochise terminal facilities, Tucson substation, schedule 3.	do	10,456
[illegible]	Missouri Basin, Wyo.	May 11	Transformers and resistor units for Kortes power plant	do	22,700
[illegible]	Missouri Basin, Nebr.	May 5	Six 50- by 30-foot radial gates for Enders Dam	American Bridge Co., Danver, Colo.	298,068
[illegible]	Missouri Basin, S. Dak.	May 21	Furnishing and erecting 20 prefabricated residences for Shadehill Government camp, schedule 1.	Fogg and Holzworth Construction Co., Miles City, Mont.	179,999
[illegible]	do	do	Furnishing and erecting 20 prefabricated residences for Bixby Government camp, schedule 2.	Brezina Construction Co., Rapid City, S. Dak., and Homeola Corp., Chicago, Ill.	183,950
[illegible]	Hungry Horse, Mont.	May 18	Furnishing and erecting 46 prefabricated residences for Hungry Horse Government camp, schedule 6.	H. & L. Building Service, Missoula, Mont.	424,461
[illegible]	Missouri Basin, Wyo.	May 11	Furnishing and erecting 16 prefabricated residences for Kortes housing at at Mills, Wyo., schedule 7.	Robertson and Dean, Casper, Wyo.	143,820
[illegible]	Columbia Basin, Wash.	May 28	Dispatcher's board and desk for left powerhouse, Grand Coulee power plant.	Control Corp., Minneapolis, Minn.	21,302
[illegible]	Colorado-Big Thompson, Colo.	May 11	Outlet pipe for Soldier Canyon Dam, Horsetooth reservoir	Basalt Rock Co., Inc., Napa, Calif.	12,092
[illegible]	do	May 21	Supervisory control equipment for control of West Portal and Shadow Mountain spillway from Granby pumping plant.	Control Corp., Minneapolis, Minn.	12,960
[illegible]	Missouri Basin, Nebr.	May 7	Construction of earthwork, canal lining, and structures for Cambridge Canal and earthwork and structures for drains.	J. A. Terteling & Sons, Inc., Boise, Idaho.	937,139
[illegible]	Klamath-Tule Lake, Oreg.-Calif.	May 21	Construction of earthwork and structures for laterals and drains in area A; and wasteway and culvert for J canal.	Ramsey Construction Co., Corvallis, Oreg.	91,655
2165	Davis Dam, Ariz.-Nev.	May 26	Steel towers for Davis Dam-Hoover Dam, Davis-Dam-Prescott, and Prescott-Phoenix 230-kilovolt transmission lines.	American Bridge Co., Denver, Colo.	1,958,416
2167	do	May 13	6 oil storage tanks for Davis power plant	Pacific Coast Engineering Co., Alameda, Calif	12,610
2168	Columbia Basin, Wash.	May 14	Coupling capacitors and carrier-current line traps for right switchyard at Grand Coulee power plant.	Westinghouse Electric Corp., Denver-Colo.	34,868
2173	Missouri Basin-Boysen, Wyo.	May 21	One traveling crane for Boysen power plant	Judson Pacific-Murphy Corp., Emeryville, Calif.	37,914
2174	Davis Dam, Ariz.-Nev.	May 26	Constructing foundations and erecting steel towers for 230-kilovolt Davis-Parker transmission line.	Charles J. Dorfman, Los Angeles, Calif.	428,139
2177	Colorado-Big Thompson, Colo.	May 14	Discharge pipe bends and 1 junction branch for Granby pumping plant	Pacific Coast Engineering Co., Alameda, Calif.	34,600
2180	Shoshone, Wyo.	May 28	Construction of earthwork and concrete chute for Willwood Canal	Sharrock and Pursel, Casper, Wyo.	46,735
2181	Boulder Canyon All-American Canal, Ariz.-Calif.-Nev.	do	Construction of earthwork, pipe lines, and structures for units 2, 3, and 4, laterals 99.8 to 119.6 and sublaterals, Coachella Valley distribution system.	R. V. Lloyd & Co., Russellville, Ark.	2,203,993
2196	Columbia Basin, Wash.	May 6	Fabricated structural steel for bus structure for right switchyard and Grand Coulee power plant.	Bethlehem Steel Co., Bethlehem, Pa.	162,385
2208	Colorado-Big Thompson, Colo.	May 28	5 radial gates and hoists for spillway at Olympus Dam	Pacific Coast Engineering Co., Alameda, Calif.	30,430
R5-2	Rio Grande, N. Mex.-Tex.	May 19	Construction of 115-kilovolt terminal facilities at Elephant Butte power plant.	Reynolds Electrical & Engineering Co., El Paso, Tex.	20,971
R6-Bis-6	Missouri Basin, N. Dak.	May 6	Furnishing and erecting 16 prefabricated residences for Government Camp at Glen Ullin.	Holm Construction Co., Glendive, Mont.	149,899
R7-8	Missouri Basin, Kans.	May 7	Sewerage and water distribution systems for Government housing at St. Francis, Kans.	Dobson Brothers Construction Co., Lincoln, Nebr.	11,292

Construction and Supplies for Which Bids Will Be Requested By September 1948

Project	Description of work or material
Boise, Idaho	Construction of laterals, earthwork, and concrete structures, Fourth Lateral unit, Canyon County, Idaho.
Do	Moving of cemetery in Anderson Ranch Dam reservoir area near Pine, Idaho.
Boulder Canyon-All American Canal, Calif.	Construction of culvert under highway and railroad near Yuma, Ariz.
Do	Pumping units for Coachella Valley distribution system.
Boulder Canyon, Ariz.-Nev.	Butterfly valves, units A3 and A4, for Hoover power plant.
Central Valley, Calif.	Construction of earthwork, lining, and structures for 27 miles of Friant-Kern Canal near Porterville, Calif.
Do	Construction of earthwork and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Radial gates and hoists for Friant-Kern Canal.
Do	Radial gates and hoists for Delta-Mendota Canal.
Colorado-Big Thompson, Colo.	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on the Big Thompson River, 1 mile of tunnel, 12 concrete siphons, 1 steel siphon, and other structures, near Loveland, Colo.
Do	Construction of 32 miles of wood pole and 6 miles of steel tower 115-kilovolt transmission line from Granby pumping plant to Estes power plant.
Do	Elevators for Granby Dam.
Do	Radial gates and hoists for Granby Dam.
Columbia Basin, Wash.	Construction of earthwork and structures for about 15.3 miles of the West Canal near Ephrata, Wash.
Do	Construction of earthwork and structures for about 8.3 miles of Potholes East Canal near Norden, Wash.
Do	Completion of Grand Coulee pumping plant, warehouses A and B, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, and water storage reservoir for Mason Addition, streets, sidewalks; assembly of face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
Do	Structural steel framing for Grand Coulee pumping plant.
Do	Freight and passenger elevators for Grand Coulee pumping plant.
Do	Elevators for right control bay at Grand Coulee Dam and power plant.
Deschutes, Oreg.	Rehabilitation of buildings, including alteration, repair, painting and decorating at Madras Air Base, Jefferson County, Oreg.
Hungry Horse, Mont.	96 inch ring follower gates for Hungry Horse Dam.
Do	96 inch hollow jet valves for Hungry Horse Dam.
Kendrick, Wyo.	Erecting foundation and 115- and 57-kilovolt bus structures for Casper, Wyo., substation.
Klamath, Calif.-Oreg.	Rehabilitation and extension of laterals and drains near Tule Lake, Calif.
Mirage Flats, Nebr.	Erection of office building, 3 prefabricated residences, warehouse, utility buildings, well pumphouse, and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Mont.	Construction of Canyon Ferry Dam and power plant, a concrete structure about 15 miles northeast of Helena, Mont
Do	Construction of concrete pumping plant and appurtenant structures on the Yellowstone River near Savage, Mont.
Do	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Moorhead Government camp, about 5 miles southwest of Moorhead, Mont.
Missouri Basin, Nebr.	Construction of Superior-Courtland diversion dam, a 300-foot long concrete overflow structure, on the Republican River near Guide Rock, Nebr.
Missouri Basin, S. Dak.	Construction of office building, garage and shop, warehouse, laboratory, mess hall, streets and walks, and installation of water and sewerage systems and other facilities at Shadehill Government camp, about 20 miles south of Lemmon, S. Dak.
Do	Construction of office building, garage and shop, laboratory, bunkhouse, streets and walks, and installation of water and sewerage systems and other facilities at Bixby Government camp, about 40 miles northwest of Faith, S. Dak.
Do	Construction of about 3 miles of access road at Bixby Dam, Perkins County, S. Dak.
Missouri Basin, Wyo.	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Keyhole Government camp, about 18 miles northeast of Moorcroft, Wyo.
Missouri Basin, Wyo.-Nebr.	Construction of about 170 miles of 115-kilovolt wood pole transmission line from Casper, Wyo., to Gering, Nebr.
Provo River, Utah	Construction of about 1 mile of 69-inch diameter steel or concrete cylinder pipe line for the Big Cottonwood secton of the Salt Lake aqueduct near Salt Lake City, Utah.

Special Excavator for Ditch Turn-Outs

ENGINEER L. M. ARMSTRONG of the Bureau's Gila project on the Lower Colorado River designed the "brain child" shown in the photograph at the left which provides economical excavation of turnouts from farm ditches. The equipment consists of a ditcher plow mounted on the trunnion bar of a D–7 caterpillar tractor and, at the right immediately below, it is shown in action. This efficient equipment excavates ditches at a rate of 24 cents per turnout as compared with $1.125 per turnout when a half-yard dragline was used. This device is practical for farm ditch excavation on various irrigation projects.

Above, after turn-out is excavated, concrete pipe is placed prior to backfilling which is done with the aid of a tractor with attached dozer blade shown at right. Cost of building excavator was $220. Armstrong's idea speeded installation of approximately 11,680 farm turn-outs on Yuma Mesa Division of the Gila Project in Arizona.

All photos by Samuel B. Watkins, Region III.

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AUGUST

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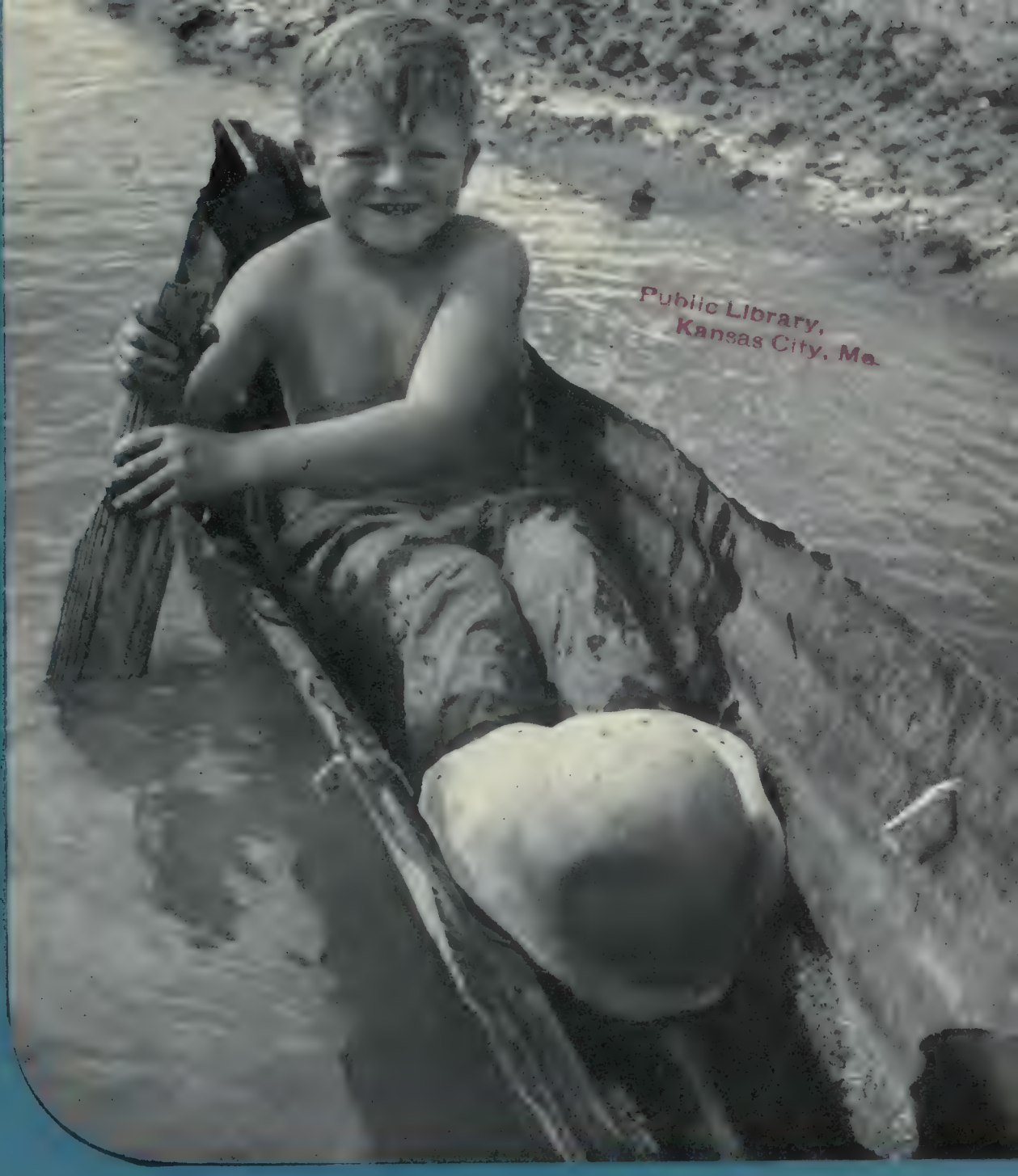
by Everett A. Pesonen

"BONIFICA" in Italy
y George E. Tomlinson



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THE

Reclamation ERA

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J. A. Krug, Secretary

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Letters to the Editor

Sentiments from Siam

BUREAU OF RECLAMATION,
Region 5, Amarillo, Tex., May 30, 1948.

DEAR EDITOR: I would like to notify you of changing my address, because I am beginning to make the inspection trip in the western part of the United States in Reclamation work and after that return to Siam.

I am highly appreciative of your kindness for sending the RECLAMATION ERA to me during my training work with the Bureau of Reclamation. I am very glad to inform you I have found the ERA useful and informative, every article is very interesting and profitable to me, and it is going to give me a great deal of pleasure to make use of these publications in studying how to practice irrigation work and

(*Continued on page 148*)

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

A reclamationist on his own is young Jackie Robinett, son of a Kendrick project, Wyoming, irrigation farmer. Here he takes time out to paddle his canoe in an irrigation ditch. He made the improvised vessel from tin roofing. Note the nail holes sealed with cloth. This photo was taken by Norton T. Novitt of Region VII.

OUR BACK COVER

We are indebted to photographer George O. Bonawit of Region III for this excellent shot of Castle Peak in the Buckskin Mountains of Arizona. This unsolicited photo was taken from the California bank of the Colorado River near Parker Dam, Calif. ERA readers will remember Mr. Bonawit for his prize-winning photo of the Arizona Canal which appeared in the January 1947 issue of our magazine when he placed third in the professional class in the Bureau's photo contest held in the fall of 1946.

MAN-MADE RAIN IS FEATURED ON THE WEST UNIT OF THE DALLES—FIRST ALL-SPRINKLER IRRIGATION PROJECT TO BE CONSTRUCTED BY THE BUREAU OF RECLAMATION

by C. E. Mohler, Engineer, Salem, Oreg., Office, Region I

A SHORT DISTANCE BELOW CELILO FALLS, where the mighty Columbia River cascades into the quiet backwaters of Bonneville Dam, lies the city of The Dalles, Oregon. Surrounding the community in this scenic locality are 4,530 acres of crop land comprising the West Unit of The Dalles project.

It is there that an advancement in Federal Reclamation will be pioneered. Water is to be lifted more than twice as high as in any pumping plants previously built by the Bureau of Reclamation, and the project is the first to be approved on the recommendation that sprinkling facilities be provided for all irrigable lands.

An Area of Hillside Orchards

Water is to be pumped from the Columbia River to hillside orchards as much as 800 feet above river level under the irrigation plan recommended and approved by Secretary of the Interior J. A. Krug in March 1948.

Various plans for irrigation of orchards in the vicinity of The Dalles were rejected in the past because of insufficient water supply or excessive costs. In fact, without two important and rather recent technological developments, irrigation of the total area would still be infeasible. The first of these two is the abundance of seasonal power from the large-scale hydroelectric plants at Bonneville and Grand Coulee Dams. It is this power, available at low cost, that will lift the water to levels previously unattainable economically.

The second development is creditable to the manufacturers of pipes, sprinklers, and auxiliary equipment. Without these devices for applying irrigation water in the form of artificial rain, it is doubtful that the steep hillsides of the area would ever be irrigated successfully. Such terrain is definitely not adapted to the traditional method of delivering water through canals and farm ditches.

Many of the lands to be irrigated lie on high, rolling hills with occasional steep, rock slopes and deep drainageways. The fairly level bottom lands along the creeks are bordered by terraces with moderate slopes. Steep and strongly rolling uplands lie above the terraces.

Soils of the area are derived from weathered rock and shale underlying the hills. They are light brown in color with surface textures ranging from very fine sandy loam to silt loam. Except for insufficient moisture, the area is ideally adapted to orchard crops. Soils are sufficiently deep and of good texture. The steep slopes prevent accumulation of cold air with attendant frost damage. A dry, sunny ripening and harvesting period can be expected in almost all years. Fruit orchards as a result occupy most of the tillable acreage. Cherries, peaches, and apricots are the major fruit crops. The acreage in cherries has remained nearly constant in recent years at 57 percent of the project area, but peaches have increased in acreage while apricots have decreased. Other fruit crops are of slight and diminishing importance.

Orchard operators and others in the area have long recognized that rainfall is inadequate for full production. Available water supplies have been adequate for irrigation of only a small acreage, however. In 1946 only some 1,500 acres received any irrigation water.

At left: Lush orchards are the result of irrigation practices in The Dalles, Oreg., area. Above: Columbia River water supply which is used to irrigate Dalles project lands. ***Left photo by Stanley Rasmussen, above by B. K. Thomas, both of Region I.***

Although temperatures and the deep soils are favorable for orchards, low rainfall permits only wide spacing of trees and practically prohibits the use of fertilizers and cover crops. The orchards are clean cultivated to conserve moisture; as a result, much soil is lost through erosion on the steep slopes. Some of the steeper drains are mulched with straw to prevent gullying. Cherries must be pruned heavily at present, as there is much dead wood and little new growth without adequate moisture. Apricots and peaches are pruned severely in order to obtain fruit of adequate size. With such severe pruning, yields of all three fruits are necessarily lower than they need be if water were available.

Benefits of the Project

Irrigation of the area should reverse the recent downward trend in crop yields and assure continued fruit production. Low yields resulting from extreme water shortages would be eliminated.

The most immediate and noticeable local benefit of project irrigation would be the increase in annual gross crop value over nonirrigated conditions. This benefit is estimated at $831,000, or an average of $183 for each of the 4,530 acres. Increased net farm income is estimated at $318,200 per year, or $70.24 per acre before deductions for value of the operators' labor, water charges, and interest on additional investment.

Much of the increased production and resulting increase in income would be derived from the use of cover crops, for which past moisture supplies have been inadequate. Cover cropping prevents gullying and sheet erosion which remove valuable top soil from the orchards. Cover-crop residues increase organic content of the soil and improve its workability. The use of commercial fertilizers, which are desirable and profitable with high-value orchard crops, could be adopted.

The erosion hazard, partly overcome by covercropping, and the necessity of pumping the water supply through pipes over the rough terrain lead to adoption of the sprinkler method of irrigation.

Recommended Sprinkling Plan

The system has been designed to supply one cubic foot per second continuous flow for each 108 irrigable acres. This capacity is sufficient to apply 4 inches of water to all project lands during the peak demand period between July 1 and 20.

The method of operation on individual farms will be, of course, left to the choice of the farm operator. A very satisfactory arrangement now practiced in the area, however, is to move lateral pipes with their sprinklers twice a day, in the morning and in the evening. Both moves can then be made by daylight, irrigation is continuous, and there is ample time for other farm work through the day.

From his service outlet, generally at the low point of the farm, the operator would arrange his own system for applying water to the fields. Farm mains should usually be run down slopes with the sprinkler laterals as level as practicable. In orchards, the sprinkler heads are mounted in the area between adjacent trees on risers short enough to throw water under the low-lying branches. The sprinkler which the growers will probably purchase has a capacity of 5 to 7½ gallons per minute, and requires a minimum operating pressure equivalent to 70 feet depth of water. Designs provide for an additional 15 feet of pressure to overcome friction losses in the farm system. Each service outlet would be supplied with a meter for measuring deliveries and with a pressure-reducing valve to provide the most advantageous sprinkler pressures up to the maximum available in the system.

Welded steel pipe has been chosen as the most economical pipe for the project distribution system. The high pressures necessary (up to almost 950 feet head) exclude most other types. Besides having low first cost, steel pipe is installed easily and requires little maintenance.

All pipe, except the small standard weights, is to be coated and wrapped on the outside. Pipe over 10 inches in diameter will also be coated with coal-tar enamel inside. As the soils in the area are neither alkaline nor acid, this treatment is estimated to provide a useful life of the pipe in excess of 50 years. All field pipe connections are to be welded, except for sleeve type couplings, installed at about 760-foot intervals to allow for pipe expansion and ease of installation and maintenance.

The first mile and a half of pipe line from the pumps to an equalizing reservoir, would be 36-inches in diameter with a wall thickness of eleven-sixteenths and a carrying capacity of 42 cubic feet per second. The next section would be of 30″ pipe with ½″ wall and continue to the reservoir without reduction in diameter but with wall thickness gradually decreasing to 7 gage. The pipe lines would be buried wherever possible with a minimum of two feet to cover.

Pipe Delivery System

The pump-reservoir and main distribution lines are to be sectionalized by gate valves so that a line can be repaired without shutting down the entire system. To reduce high stresses caused by a sudden halting of the flow of water, these valves would be of a slow-closing type. Combination air-release and vacuum valves would be placed at all high points of the line, at all abrupt breaks in slope, and immediately below gate valves to permit escape of entrapped air when the system is operating and to eliminate collapsing stresses when it is emptied suddenly. Blow-off valves would be installed at all low points and just above sectionalizing gate valves to drain the line for repairs or to protect it from freezing after the end of the irrigation season.

Lateral pipe lines are laid out to serve as large an area as possible and thus reduce the size of the main line beyond the lateral connection. The laterals would follow the ground profile and be buried at least two feet. Service connections would be made to the laterals at the lowest point of the farm to be irrigated. Each farm would receive one or more service outlets, except for areas of less than one acre, which would share an outlet. Blow-offs, air and vacuum valves, and shut-off valves would be installed wherever required in the laterals.

An equalizing reservoir lined with concrete would be provided to maintain more uniform pressures and aid in operating the pumps. The reservoir would have a capacity of 1.5 acre-feet (about 490,000 gallons). Water surface of the

(Continued on page 154)

Sacramento Salmon Resettled

New "Nursery" for salmon propagation established below Shasta Dam

by Everett A. Pesonen
Recreation Specialist, Region II, Sacramento, Calif.

The familiar magazine cover picture of a big buck salmon rocketing up a waterfall against gravity and the plunge of the stream, truly shows you not only the great size and strength of this magnificent fish, but also the tremendous driving power of the instinct which sends him back from the furthest ocean to spawn in the river that bore him.

The salmon's urge to complete his existence in his own home stream makes possible the multimillion-dollar fishery of the Pacific Coast. And it also makes concern for the salmon's welfare a major consideration in building dams across West Coast waterways. Exhibiting this concern, one of the largest "salmon salvage" programs on any Pacific Coast river has been undertaken by the Bureau of Reclamation at Shasta Dam, key unit in California's Central Valley project, a 600-foot-high concrete barrier below the junction of the four principal streams that form the main stream of the Sacramento.

When Walker R. Young, Construction Engineer, arrived in 1935 to set in motion the machinery for building Shasta Dam, he found that salmon had been forgotten in the concern for water conservation. No provision, he found, had been made in project plans to compensate for ancestral spawning grounds which the dam would cut off. The salmon's plight was called to Mr. Young's attention by the California Division of Fish and Game and the United States Bureau of Fisheries (now a part of the Fish and Wildlife Service). There was no information on which to base a conservation program; apparently everyone had taken the presence and persistence of the salmon for granted. So Mr. Young saw to it that funds were allocated from the Bureau's appropriation and enlisted the aid of the fish conservation agencies in working out means to relocate the runs below the dam.

In 1938 a platoon of biologists and engineers, under the direction of Dr. Paul R. Needham of the Bureau of Fisheries set to work on the problem. They were to determine the numbers of salmon involved, to survey downstream areas where they might be relocated and to devise artificial measures to compensate for the stretch of river to be cut off—if alternative streams and spawning areas could not be found.

A counting station was set up at the Anderson-Cottonwood

Top right: Closeup of large female salmon. Note teeth and undershot jaw of male lying on slats outside box. Immediate right: Fish scales are used to determine salmon food consumption. Lower left: Removing salmon from Battle Creek for artificial spawning; Below: Fish truck discharging salmon into holding basin at Coleman Hatchery. ***Photos by W. W. Nell and J. E. Fluharty, Region II.***

MR. FISH takes a trip. In top photo, about 40 large chinook salmon battle the fish trap at Keswick Dam. But it's a losing fight and they are gradually forced into the gate and elevated to the top of the Dam where they are deposited in Fish and Wildlife refrigerated truck (center) for trip to Deer Creek. In bottom photo, water is pumped into the truck from the future propagation stream to acclimate the imprisoned salmon to their new home. ***Photos by J. E. Fluharty, Reg. II.***

irrigation district dam at Redding, to keep a tally of every salmon leaping the narrow weir through which the runs were funneled. The cobbled gravel riffles of the Sacramento, McCloud, and Pit Rivers and their tributary creeks were surveyed. Forty square feet was allowed for each salmon nest in calculating spawning areas cut off and estimating the adequacy of the substitute grounds.

Time pressed the investigators. The minimum period for counting the size of the runs is 4 years, the usual life cycle of the chinook salmon. But both the investigations and the plans for "salvage" had to be completed within 2 years. To assure the best possible solution, the Bureau selected a "Board of Consultants"* to evaluate the findings and recommendations of the investigators and to recommend a plan from the various alternatives proposed.

The Board finally selected a scheme advanced by Fred J. Foster, Director of Fish Culture in the Bureau of Fisheries. His plan was based on the gloomy promise that Shasta would cut off a good 60 percent of the spawning in the entire Upper Sacramento River system.

The Foster plan provided for taking care of 25,000 fish, the number estimated to spawn above Shasta Dam, by transferring 3,000 of the spring run 60 miles south, to Deer Creek, and 3,000 more to holding ponds to be established 30 miles downstream, in Battle Creek. The purpose of the transfer was to escape high water temperatures anticipated to prevail in the river. In addition, 4,000 fall-run fish, expected to arrive before the water cooled, were to be trapped and transferred to Battle Creek for holding and artificial spawning during the period that the dam was under construction. All fall-run fish were to be left to spawn naturally in the river after the dam was in operation.

By 1943, Bureau designers, working with Fish and Wildlife Service experts, were ready to carry out the Foster plan with a unique fish trap in Keswick Dam, an afterbay structure 9 miles below Shasta Dam. In this trap the fish, lured by a series of weirs resembling low waterfalls, end up in a flytrap entrance into a hopper-shaped elevator. The elevator rises up through the dam to a derrick perched on the crest. Here the fish are dumped into special tank trucks, which are equipped with refrigeration and aeration pumps, and are hauled 30 miles to Coleman Hatchery, another major unit of the salvage plan.

At the hatchery, racks or barriers are provided in Battle Creek to hold the fish until "ripening" in September, October, and November. Eggs are removed from "ripe" females, fertilized with milt from the males and placed in hatching trays, where they are kept in running water until they hatch, about 60 days later. In four to eight weeks after hatching, the yolk-sac of the egg, which remains attached to the fry (or parr), as the young fish are called, is absorbed and the "fingerlings" are ready to feed. Soon after, they may be released to start their 300-mile journey to the Golden Gate and the open sea.

For four years, up to and including 1946, spring-run salmon were hauled to Battle Creek and Deer Creek according

(Continued on page 160)

*The three members of the Board were R. C. Calkins, now Dean of the College of Commerce, Columbia University; W. F. Durand, Professor (Emeritus) of Mechanical Engineering, Stanford University; and Willis H. Rich, Professor of Biology, Stanford University.

EDITOR'S NOTE: This is the second and concluding part of an article reprinted from the May 15, 1948, issue of COLLIER'S through the courtesy of its editors and the special permission of Associate Editor Lester Velie, the author.

ARE WE SHORT OF WATER?

(Part Two)

By LESTER VELIE

Other Americans are learning to import water, too. At Coalinga, Calif., drinking water must be hauled in by tank cars from 45 miles away. The town's wells finally had gone so deep they hit salt beds which made the water unfit to drink.

Long Beach, Calif., scene of vast aircraft production during the war, isn't importing drinking water yet, but galloping salt encroachment from the sea is giving the town a bad fright. Thirsty war factories and a mushrooming community gulped so much water from underground pools that water levels, once above the sea, are now as much as 75 feet below sea level. As the fresh water retreats, the ocean seeps into the water-bearing beds and puts wells out of business. Already in possession of a 2-mile beachhead, the salt water invader is pushing forward several hundred feet every year, and townsfolk talk of building a sort of underground Maginot line of concrete to contain it.

But the trouble lies not only in the Southwest. The Middle West, and East, too, generally unperturbed about water, are drawing down their underground supplies. Water levels under the downtown district of Louisville, Ky., have dropped 40 feet in 10 years, and in the town's outskirts, distillers and synthetic-rubber producers hoard their water like misers to forestall their warborn dread—vanishing water. At Indianapolis the water table below the center of town is down as much as 50 feet. Air-conditioning systems, the newest arrivals at the water trough, have been gulping giant draughts of the city's water and are posing this hard question for the rest of America, too: What to do about it?

Baltimore had to reduce pumping at the beginning of the war when wells became contaminated with salt. Philadelphia's water has been tasting more like Epsom salts every year. Brooklyn's water used to arouse as much comment as the Dodgers because overpumping pulled it down 35 feet below sea level and gave it a rank, musty taste.

"The way we've used up our ground water without regard to the way nature puts it back is scandalous," said government geologist Sayre.

A limiting factor now on industry and agriculture in some areas, the scarcity of water will dry up our future growth unless we know how much water is available and then use it wisely, he added. We can only go as far as our water will go.

Here's why: It takes 65,000 gallons of water to produce a ton of steel (water is used chiefly for cooling). It takes 7 to 10 gallons of water to produce 1 gallon of gasoline. It takes fifteen gallons of water to make 1 gallon of beer. It takes 800,000 gallons to irrigate 1 acre of oranges. And when we get around to making synthetic fuel from coal or shale it will take as much as 50,000,000 gallons of water per plant per day. Where's the water coming from? Much of it will have to come from wells, for more than half of our daily water—or 20,000,000,000 gallons—comes from underground.

The industrial East has its water troubles cut out for it. The problem is growing, but things are coming to a head in the arid and semiarid Southwest. In California there are two kinds of weather: "perfect" (which means all sunshine) and "unusual." San Diego calls itself "heaven on earth" because it rains only nine days in a year. Rain is rare in southern California and in the Southwest from May through September. The fertile land there is largely a reclaimed semidesert area that by the grace of water taken from underground or rivers is blooming with oranges, dates, cotton, grapes, and alfalfa. As one California farmer put

At left: Good wells are hard to find. Only a dribble comes from this one at Fairfield, Calif. At right: This parched orchard, near Friant-Kern Canal (under construction) was abandoned when water gave out. ***Left photo by J. E. Fluharty; right by B. D. Glaha, both of Region II.***

it: "You're just a slave to your well, or to your irrigation ditch."

It's not his name, but call him Elmer Clay. Clay has his grove in lush San Joaquin Valley. Nightly he would be lulled to sleep by the double-beat, sighing rhythm of his well pump.

With each stroke, the rod and plunger would shoot 400 feet into the earth and force up the gushing water. Down, up, down, up, chough, chough, chough, went the pump, playing a lullaby. That meant to Clay that all was well with his world; that his 20 acres of oranges would bloom, that tiny Valencias would come and grow steadily through the rainless summer and fall. Then one night he sat up suddenly in bed, awakened as rudely as if a bell had clanged in his ear. But he hadn't been aroused by a sudden noise. He had been awakened by a sudden silence.

It was the pump. The even beat had ceased, and now after a moment there came an uneven hammering. The next morning Clay knew the worst. His well was dry. His pump was sucking air and rattling itself to pieces. A new well and pump would cost at least $4,000. Already mortgaged beyond his means, Clay bitterly turned away from his grove.

"Banker, come and get her," he said.

From Poor Richard

"When the Well's dry, they know the worth of Water."
—Benjamin Franklin's Almanac

Clay had cause to be bitter. He had bought his grove just two years before, paying $2,000 an acre for it. A fantastic price? You might as well have tried to convince an old forty-niner the investment in his gold diggings was too steep. For gold is coming to California's 500-mile-long Central Valley—liquid gold in the form of river water. The Government's Bureau of Reclamation will spend more than $3,000,000,000 in the next decade to alter the courses of 2 rivers, build 20 reservoirs and cut a dozen canals to open up land for 50,000 new farms. *(This is in the planning stage—Ed.)*

But the new canals are still some years off, and Elmer Clay's well gave out before Government water could come to the rescue. Other wells throughout the valley are giving out too. The reason is that, lured by the promise of ample water, farmers and speculators have started a land rush, opening up arid lands, sinking more wells and sinking them deeper, and draining off the underground water.

"Let me show you what's going on in this valley," Richard Stark, a prosperous orange grower at Lindsay, Calif., urged. "You've got to see it from the air to appreciate it."

We climbed into a four-seater Fairchild and were soon bumping along high over the southern San Joaquin Valley, with its geometric pattern of orange groves, cotton and vegetable farms and white towns. From an altitude of 1,500 feet, evidence of the great drought could be seen everywhere. To the west, the peaks of the Sierra Nevada wore tiny caps of white, and through the afternoon haze the foothills showed a uniform, dusty brown.

"What a pitiful sight!" Stark exclaimed. "At this time of the year (early March) the mountains are usually white with snow halfway down their sides and the foothills are a deep green. Those grazing lands," he continued, pointing to a bare gray waste of land, "should be ablaze with poppies and lupins. This year there's nothing."

The grazing lands were as bare of cattle as they were of flowers. Some 100,000 head of steers had been shipped to Idaho and Colorado and whatever other States could provide pasture.

"Now watch this," Stark said, as we passed over the parched bed of the Tule River and swung south toward Bakersfield, the southern terminus of the Central Valley. Below there appeared signs of vast activity which even a newcomer to the area couldn't mistake.

We could see, interspersed among the green patches of old cultivated land, thousands of acres of raw land being newly rolled and leveled in preparation for planting. With their straight-cut furrows the newly broken lands stretched away as far as the eye could see, like so many pieces of precisely ruled graph paper.

High prices for cotton and onions and carrots and lettuce and spinach were luring hopeful farmers to break the raw lands. So was the prospect of ample, new irrigating water. Both attractions may lead the farmers into a tragic trap.

"Every one of those thousands of newly broken acres down there will have to be irrigated with water from wells," my guide said. "We have no other water yet. That means we'll need one and a half to three additional acre-feet of well water for every new acre. Now, where's the water coming from?"

Because there's a power shortage in California as well as a drought, Central Valley farmers may not be able to keep their pumps going the required 24 hours a day, and so they face disaster this summer. But even if there were no power shortage, the arithmetic of the water situation just doesn't add up.

The point is that a canal, now under construction, the Friant-Kern, will bring 800,000 acre-feet of water annually into an area that now needs about 2,000,000 acre-feet. That leaves a deficit of 1,200,000 acre-feet to be made up by pumping. But nature doesn't put that much water underground each year into the southern San Joaquin area, and the water must inevitably give out unless ways can be found to recharge it artificially.

The exhausting of the water supply has gone a long way. At Delano, which lies in the heart of the newly developed country, underground water levels have dropped 220 feet in 20 years, and wells now reach 1,200 feet into the bowels of the earth. Other districts all over the San Joaquin Valley are losing their water at alarming rates. Someday soon California must cut its farming to fit the water supply.

If the water situation in the San Joaquin Valley keeps farmers awake nights trying to figure some way out, the problems in addition and subtraction posed by the Colorado River are still more of a nightmare to the whole Southwest. Once a savage torrent that terrorized the desert country with its floods, the river has been tamed by three monumental dams and loaded down with a water-supply burden too much even for its great resources. It furnishes power and water to *seven* States.

Man proposes great plans for southern California, Nevada,

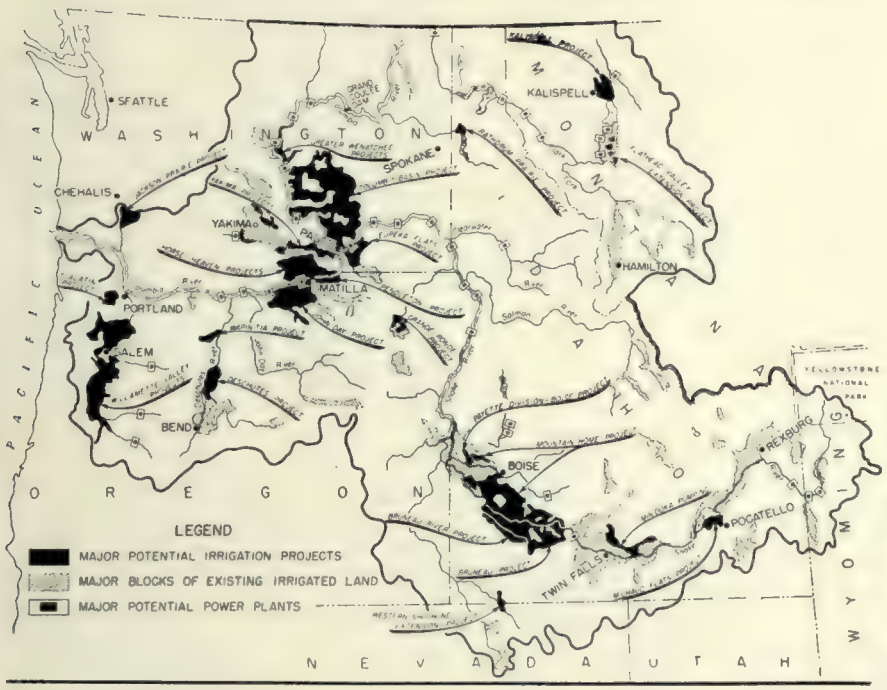
(Continued on page 148)

FLOOD DAMAGE in the COLUMBIA BASIN

Front page news featured the 1948 flood in the Pacific Northwest where several major Reclamation developments are located. Among those to feel the fury of the flood most seriously was Grand Coulee Dam. Here the high water washed away considerable sections of the heavy protective blanket of rock on the river banks immediately below the dam. Three shifts of emergency crews swung into action and carried on protective maintenance throughout the floods holding the damage at a minimum and taking necessary action in the event of possible slides. Emergency electric service facilities were installed in the Government hospital at Grand Coulee because the power circuit serving the portion of the town of Coulee Dam on the east side of the river was severely threatened. The power output at Grand Coulee Dam was reduced from the overload peak of 125,000 kilowatts per generator to the nameplate capacity of 108,000 kilowatts. There are nine of these huge generators in operation at the plant.

Emergency calls for men and equipment available at Grand Coulee Dam were received from various points in the Okanogan and Wenatchee Valleys as well as the hard hit Portland-Vanport zone. Every possible assistance was rendered to these stricken areas as well as occupants of a number of houses near the right bank of river below Grand Coulee Dam.

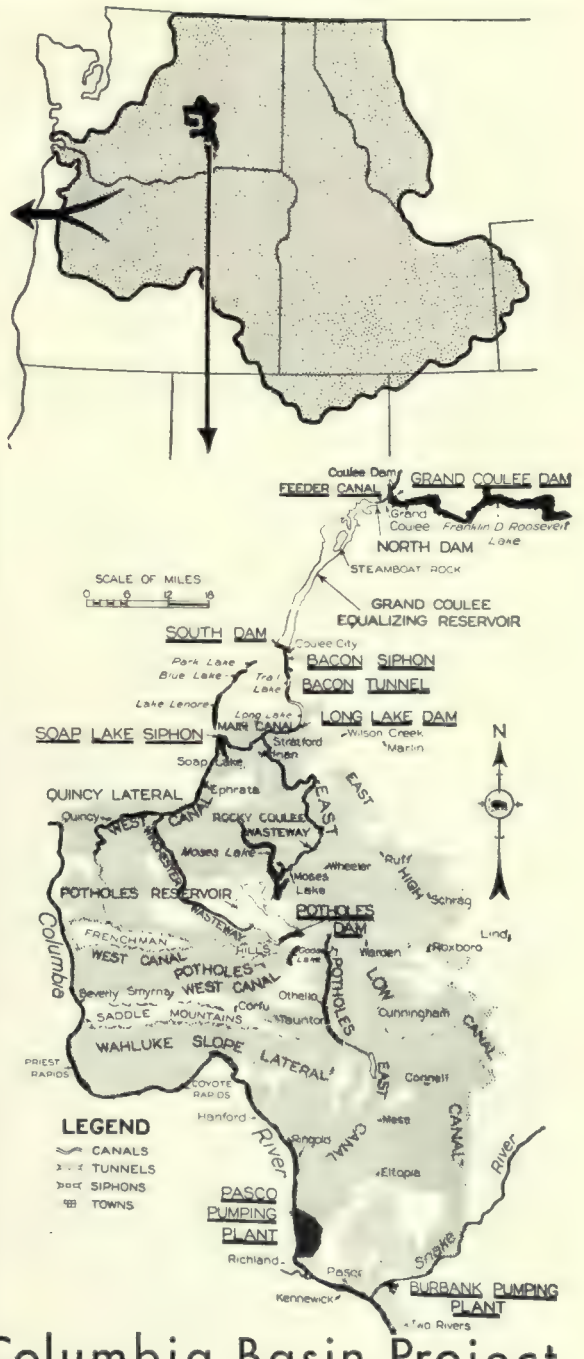
Columbia River Basin Plan



SEE THE DIFFERENCE?

Strange as it may seem, we have had inquiries which showed that people are beginning to confuse the Columbia River Basin Plan with the Columbia Basin project. Although the names are similar, there is a big difference as you can see. Directly above is a map of the Columbia River Basin Plan, while at the immediate right is a map of the Columbia Basin project, now under construction. In the upper right hand corner an outline drawing shows the over-all Columbia River Basin Plan in gray with the Columbia Basin project identified by the small black area.

The River Basin Plan would provide for the development of natural resources in five States, namely Idaho, Montana, Oregon, Washington, and Wyoming, while the Columbia Basin project provides for such development in the State of Washington only. This project with almost half of its power facilities completed and work well under way on the irrigation system which will ultimately irrigate approximately one million acres of rich farm land actually would form a nucleus for the River Basin Plan.



Columbia Basin Project

Are We Short of Water?

(*Continued from page 146*)

and Arizona. But the Colorado River disposes. One of these days it will serve an ultimatum: The feverish growth of the Southwest must stop! The seven dependent States have made claims on the Colorado that add up to more water than it can furnish them. Someone someday will have to decide which areas shall stop growing.

The two States most determined to grow and live in the manner to which the war accustomed them are California and Arizona. More people have moved to California during the last several years than there are in the whole State of Virginia. About 2,000 migrant families pour in every week. On a smaller scale, Arizona has enjoyed a similar expansion. The consequent cries for water have the desperation of a thirsting camel driver.

All this proves that the energies of westerners, as well as easterners, are likely to be directed toward opening up new supplies of water or battling over old ones. Little effort has as yet gone toward conserving water, the only alternative.

Underground Water Laws

Only 8 of the 48 States have laws governing the use of underground water. In the others a man is free to punch a hole down into the earth until he strikes water. If he drains off a neighbor's supplies there's nothing that the neighbor can do about it. Or if an office-building owner wants to use his town's underground resources for air cooling, there's nothing to stop him, either, from letting it run down the drain after he is through with it.

Most of the eight States that conserve their underground water passed their laws under compulsion of bitter necessity. The Roswell Basin in New Mexico used to boast huge flowing wells that yielded 9,000,000 gallons daily. By 1925, many wells had stopped flowing. The artesian water levels were sinking. As the water table went down, money interest rates in the area went up. Bankers would take no chances on farm land whose water was failing. The State called in the water experts of the United States Geological Survey. They found the wells were losing water through holes in the casings and that, anyway, the water was being overpumped.

A State control law, passed in 1930, requires permits for drilling wells and empowers the State engineer to require that leaking wells be plugged. This has been a successful conservation program. Forty-five thousand acres were being irrigated in the area in 1930. Now the figure is 100,000 acres. And interest rates are down again.

A New York State law requires that for every well sunk to provide air conditioning in the four Long Island counties, which include Brooklyn, another must be used to return the water to the ground.

The average American requires more than 100 gallons of water each day. Only part of it is used for drinking or washing. Most of it is needed by the industries or farms that support his community. Europeans use only a quarter of this—a key to the difference in the standards of living. Like the car and the radio, ample water is part of our way of life. It is even part of our national defense. During the last war some 300 proposed war-plant sites had to be discarded because of water scarcity. Should another war come, geologists warn us, it would be more difficult to locate plants than ever before. The situation, geologists insist, is by no means hopeless. But as in the case of our mineral and other resources, it is time we take stock of how much water we have and learn how to use it without using it up.

One hundred and forty-five millions of us can't live on this continent of ours without drawing on its water. We found we could use wood and still conserve trees. We can do the same with water. It looks as if we'll have to stop letting our most basic resource flow down the drain. THE END

RIVERTON MAP

A new Riverton Project map has just been received from the printer.

Map No. 48–4, in 4 colors, red, blue, green and black, size 10½ x 17 inches, price 15 cents.

Same map, size 21 by 34 inches and numbered 48–4A, price 25 cents.

Copies of these maps can be obtained by sending check or money order payable to Treasurer of the United States, to Director, Region 6, Bureau of Reclamation, P. O. Box 2130, Billings, Mont. Stamps are not acceptable.

Dam Named for O'Sullivan

James O'Sullivan, popularly known as the "Grand Old Man of Grand Coulee Dam" (See November 1946 Era) was recently honored for his efforts to make the Columbia Basin project a reality, when President Truman signed Senate Joint Resolution 202 which changed the name of the Potholes Dam in the Columbia Basin project to the O'Sullivan Dam.

Letters to the Editor (*Continued from page 2 of cover*)

everything in engineering, which I appreciate very much. I believe the RECLAMATION ERA will be very interesting to Siamese engineers when I return to Siam.

Very sincerely yours,

CHAIN ATTHAYODHIM,
Siamese Engineer.

Words to Remember

Merriman Bros. Inc., manufacturers of marine hardware, blocks and rigging, self-lubricating bearings, powder metallurgy products, megaphones, of 185, Amory Street, Boston 30, Mass., sent us a letter which contained the following heart-warming sentiment:

"* * * we do not wish our subscription to your publication to ever run out, and will certainly see to it that it is paid up well in advance."

"*" Bonifica" in Italy

*The Italian word for reclamation. Loosely translated it means "for the good of the land."

by George E. Tomlinson,

Assistant Director of Branch of Project Planning, Bureau of Reclamation

Dr. M. A. McCall, Assistant Chief of Bureau of Plant Industry, Department of Agriculture, Counsel Aldo Loni of the Foreign Office, and George E. Tomlinson, Assistant Director of Project Planning, Bureau of Reclamation, discuss calcium deposit as part of fight on foot and mouth disease at Arborea.

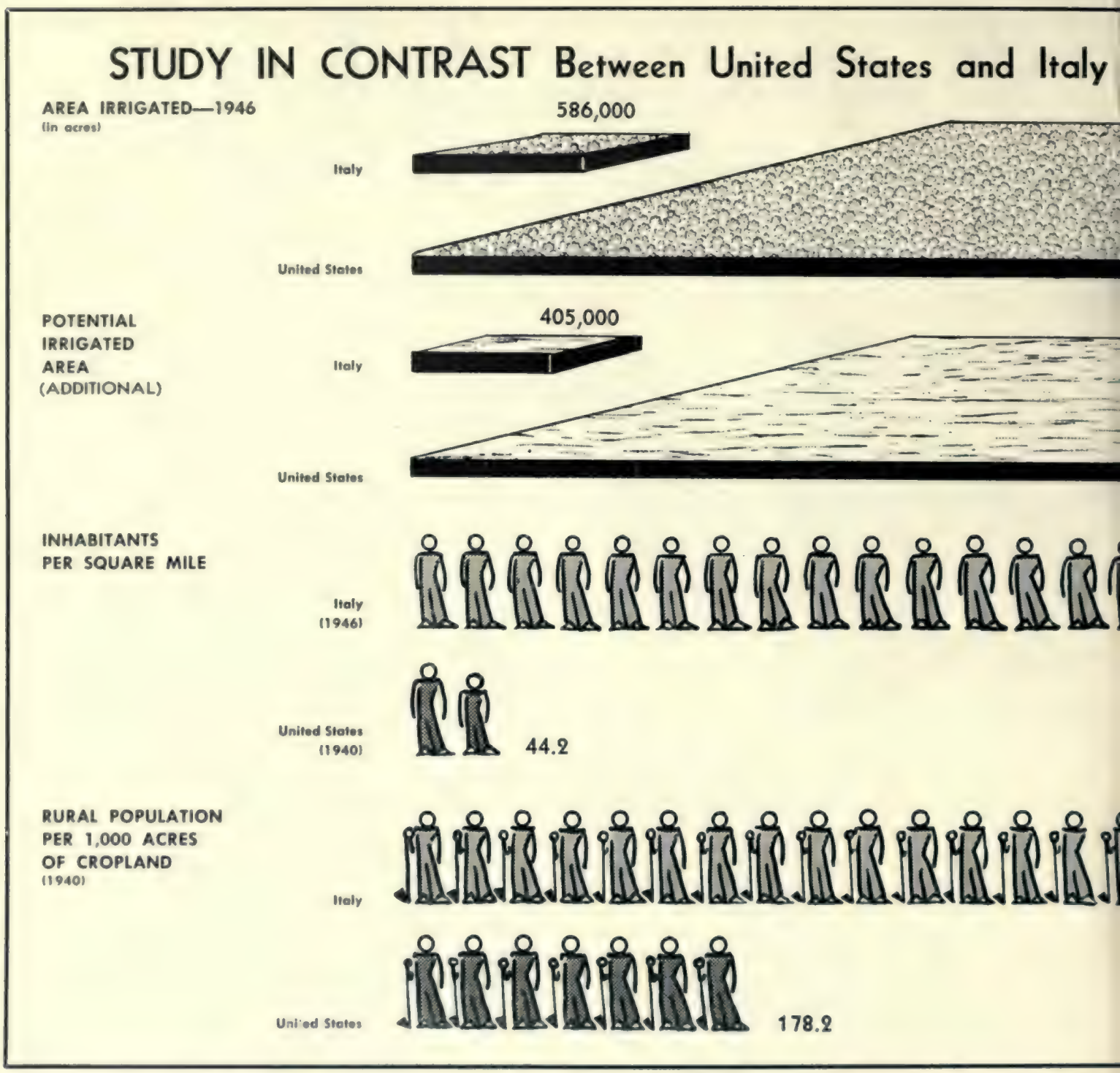
"WHAT ITALY NEEDS IS RECLAMATION!" This is what farm leaders everywhere told us on our recent tour through the ancient lands of the Romans.

The United States State Department, at the request of the Italian Government, sent a Technical Mission to Italy to survey the possibilities of further development of irrigation, agricultural and hydroelectric resources in Southern Italy, Sicily, and Sardinia. This mission, composed of Dr. M. A. McCall, Assistant Chief of the Bureau of Plant Industry, Department of Agriculture and the author, traveled extensively by airplane, automobile, train and on foot, in the 6 weeks devoted to this survey.

We were joined by outstanding Italian engineers, agriculturists and economists to form a joint Italian-American Committee. On our tour of the several areas we observed existing and proposed projects in the irrigation, drainage, hydroelectric and general agricultural fields and became acquainted with problems and opportunities in the area as a whole. The areas covered by the survey are generally recognized as being the areas with the most serious problems in all Italy.

The Italian farmers, like some of our own farmers here in the United States, are handicapped by too little rain or too much rain at the wrong time. The annual rainfall is usually 30 inches or less, and frequently less than 10 inches. To make matters worse, the distribution of the precipitation is very poor, resulting in maximum stream flow in winter and early spring, with less flow or none at all at other times. Most of the streams were dry when we visited there in April and May, although there was considerable evidence of serious flood damage earlier in the year.

The Italian topography ranges from flat coastal plains, through rolling country, to mountainous areas. Unfortunately, the percentage of level land is small with the result that too large a percentage of land on the steeper slopes is used for grains and other crops. This land has been farmed



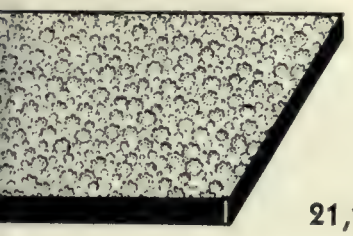
for many centuries. The "age" of the country is a matter of public pride. We saw the partially restored city of Pompeii which was destroyed by Vesuvius in 79 A. D.; cathedrals, such as the "relatively new" one at Lucera which was built in the 13th century, and the still-intact fortresses, called Nuraghas, in Sardinia which are estimated to have been built about 5,000 B. C.

I was especially interested in an ancient dam, the Grotticelli in Sicily. This aged structure, though overburdened with the weight of years of silt, is still in use today. You'll notice in the picture the old and "new" sections. The lower part was built by the Arabs in the 12th century; the dam was remodeled and raised in 1563; and it was remodeled again in 1926.

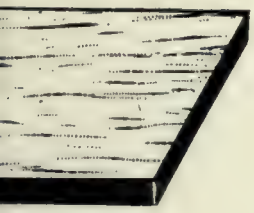
Speaking of age in Italy, one of their great problems is the long and continued use of the land. In Sicily and South Italy in particular, and to a lesser degree in Sardinia, population pressure is so great that the amount of presently available good land is insufficient under the present systems of intensified use. This unhappy combination makes it necessary to force lands into cultivation which either should not be farmed or should be cultivated only by the most careful methods to prevent erosion and serious deterioration. The situation is critical not only because it seriously lowers living standards of peasants on such lands, but also because it is a menace to soil resources in extensive areas.

The long and continued use, and *over* use of the land has taken its toll in the form of heavy erosion in the upper reaches

thern and Insular)



21,120,000



17,000,000

4.5

429.0

Basic Statistics

	Southern Italy (continental)	Sicilia	Sardinia	Total (southern and insular)	United States
Total area (1,000 acres):	18, 102	6, 350	5, 952	30, 404	[1] 1, 903, 000
Nonagricultural, nonforest use	[2]	[2]	[2]	[2]	[1] 53, 000
Nonbeneficial use	743	323	212	1, 278	[1] 77, 000
Agricultural and forest use	17, 359	6, 027	5, 743	29, 129	1, 773, 000
Land use of agricultural and forest area (1,000 acres):					
Area in pastures, forests and woodland	6, 483	1, 150	4, 132	11, 765	[1] 1, 315, 000
Cropland harvested	10, 692	4, 862	1, 611	17, 165	[1] 359, 000
Other cropland and farm use	[3] 184	[3] 15	[3] 0	[3] 199	[1] 99, 000
Percentage distribution of land use:					
Pastures, forests and woodland	37. 3	19. 1	71. 9	40. 4	74. 2
Cropland harvested	61. 6	80. 7	28. 1	58. 9	20. 2
Other cropland and farm use	1. 1	0. 2	0. 0	0. 7	5. 6
Area irrigated (1,000 acres):					
1946	339	215	32	586	21, 120
Potential (additional)	269	74	62	405	17, 000
Population (1,000):					
Italy:					
1911	8, 548	3, 672	852	13, 072	
1936	10, 652	4, 000	1, 034	15, 686	
1946	11, 489	4, 356	1, 196	17, 041	
United States:					
1910					[4] 91, 972
1930					[4] 122, 775
1940					[4] 131, 669
Rural population (1,000):					
Italy, 1936	5, 093	1, 784	525	7, 402	
United States, 1940					[4] 57, 246
Percent of total	47. 8	44. 6	50. 8	47. 2	43. 5
Inhabitants per square mile:					
Italy:					
1911	314. 9	390. 1	95. 1	290. 6	
1936	392. 6	424. 8	115. 3	344. 5	
1946	423. 5	451. 7	133. 4	374. 5	
United States:					
1910					30. 9
1930					41. 2
1940					44. 2
Rural population per 1,000 acres of crop land	477. 5	364. 2	323. 8	429. 0	[5] 178. 2
Power (kilowatts) 1946:					
Hydroelectric installed	761, 666	70, 124	45, 506	877, 296	[6] 14, 848, 491
Hydroelectric potential	412, 836	180, 831	96, 980	690, 647	[5] 77, 130, 000
Other installed	51, 847	38, 195	33, 570	123, 612	[6] 35, 468, 130
Total installed power (kilowatts) per 1,000 inhabitants	70. 8	24. 9	66. 1	58. 7	382. 1

[1] Data for 1930 from National Resources Board's Report of Dec. 1, 1934.
[2] Not reported.
[3] Not reported. Computed as difference between total area in agricultural and forest use and the sum of cropland harvested and pasture, forest and woodland area.
[4] Source—U. S. Census.
[5] Rural population 1940 (57,246,000) and cropland harvested in 1940 (321,242,000 acres).
[6] Source—U. S. Federal Power Commission.

of the river basins and the inevitable byproduct—heavy deposits of the eroded soil, gravel, and boulders in the low lands near the coast line.

It was not difficult to recall the legend concerning King Alaric of the Visigoths, who died at Cosenza in the sixth century after conquering Rome. The Goths, incidently, gave us our gothic style of architecture. The legend relates that his followers buried the king next to the Busento River and then diverted the flow over his grave for a short while. After the silt deposits had completely hidden the grave, the dikes were mended and the river returned to its regular channel. Although the accuracy of such a story is subject to some question, it does support the belief that for many, many years, these streams have been carrying tremendous loads of soil and other materials, eroded from the upstream areas.

In the coastal low lands the river has brought down such heavy loads of eroded material that efforts to confine it to its banks by levees and keep it off the adjacent lands have resulted in a gradual raising of the river bed. Restrained only by concrete side walls, the river, now in effect a huge "aqueduct," several hundred feet wide, flows through the valley at an elevation of more than 10 feet above the surrounding country.

The resourceful Italians make the best of the unfortunate distribution of their meager rainfall which comes at such inopportune times. For example, in the coastal area between Foggia and Bari, engineers have diverted the floods of the local rivers into diked-off marsh areas. Over the past 100

years they have been able to reclaim about 12,000 acres, by filling to a depth of six feet or more with the sedimentation thus "milked" from the flood water. This is a slow, gradual process, but one which is being prosecuted continuously with the reported objective of eventually reclaiming a total of about 25,000 acres in that area.

Enterprising peasants who have settled in the marsh country in nearby areas have built their tiny farmsteads by laboriously using baskets, or in some cases carts, to carry precious soil to these small tracts of low land that they have acquired by exercising "squatters' rights." These little farms have been enlarged over several decades until most of them now contain a couple of acres or more. Nature has not favored these people any too well. Although they are relatively safe from the ravages of water erosion, they have to take back-breaking measures against wind erosion. Figure 2 shows how a farmer has carefully placed straw between the rows to anchor his "farm."

Italian farmers in a number of coastal areas are faced with still another land problem—that of salinity, if they pump too heavily from the high ground water table.

We observed a different form of land reclamation in an area near Foggia where relatively flat land was underlain with a stratum of limestone rock 12–18 inches thick and lying so close to the surface of the ground (15–20 inches) as to make farming impracticable. Because of the scarcity of land, the owners of this property were removing this ledge of rock by hand labor. This is a costly, slow process of reclamation. Because of recent changes in the exchange rate between the Italian lira and the American dollar, money values are meaningless to the average reader; however, it is estimated that in the neighborhood of 400 man-days of labor are required per acre for this method of acquiring more land to cultivate.

To understand Italy's reclamation needs we should look at a few figures on acreage, population, and extent of power development. The lack of kilowatts for farm and industry will be discussed in a separate article. Italian members of the study group supplied the basic Italian information for the table on page 150. For comparison purposes, corresponding data concerning the United States are given.

These figures show that Italy needs more good land under cultivation to feed her increasing people. The population in over-all Italy is growing at the rate of about 400,000 persons a year, or at a net annual increase of about 0.85 percent. The increase in Southern and Insular Italy is higher than the national average. Consequently, it appears that the already overpopulated areas are becoming more crowded.

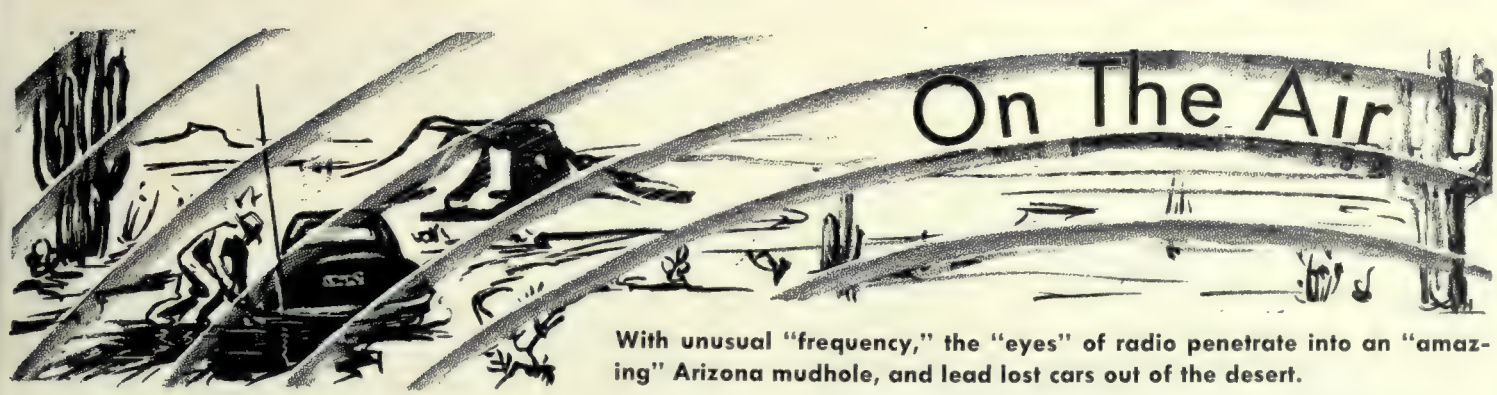
There are plenty of persons available for work throughout Southern and Insular Italy; many of them are both hungry and unemployed. Estimates of presently unemployed Italians range in the neighborhood of 2,000,000. These persons are mostly unskilled, untrained, uneducated, and illiterate. However, they are reported to be good workers, and from the evidence which we observed, they do well with tools they know how to use. In Italy they build by hand as much as possible, to take advantage of the available supply of labor and also to avoid the limitations imposed by a severe shortage of practically all building materials other than stone masonry. Most of the construction designs call for structures using the minimum amount of lumber, steel, and other materials, even though the amount of hand labor exceeds by far the proportionate amounts which would be considered good practice in this country. But to get back to the subject of the farmer, the tenant situation has contributed to Italy's acreage problem.

It is very difficult, if not impossible, to draw definite conclusions on land reclamation in Italy based on such a brief reconnaissance. The following observations are presented merely to point out a few of the many interlocking problems that need to be resolved.

Land in Italy is generally controlled by large land owners. These holdings are frequently rented to a tenant who pays an annual rent and in turn has the land divided into small areas, each of which is farmed by one or more peasants on a share-crop basis. This practice frequently results in the tenant attempting to earn as much as he can from the land without returning much of his profits to the soil, to farm facilities, or into permanent improvements. Consequently, in many instances, the land has deteriorated over the years to a point

(*Continued on page 156*)

Below left: Grotticelli Dam, Sicily. Lower part built by the Arabs in the 12th Century; remodeled and raised in 1563; remodeled in 1926; silted up but still useful for irrigation diversion. Below right: Small bunches of straw used to prevent wind erosion, east of Zapponita.



With unusual "frequency," the "eyes" of radio penetrate into an "amazing" Arizona mudhole, and lead lost cars out of the desert.

by M. M. McINTIRE, Chief, Power Operation and Maintenance Division, Region III, Boulder City, Nevada

L. C. McCormick and O. K. Mangum, Parker Dam Power Project, display portable transmitter used for patrol and maintenance crews on line system. ***Photo by M. M. McIntire, Region III.***

IT JUST COULDN'T HAPPEN—BUT IT DID.

Florida and California may have many differences over weather and may be rivals for the tourist dollar but it is evident that there is a very friendly spirit of cooperation between Florida and Arizona—at least between the Soil Conservation Service in Florida and the Parker Dam Power project of the Bureau of Reclamation in Arizona.

Recently O. K. Mangum, engineer in charge of operation and maintenance of the Parker power system in Central Arizona, and just now actively engaged in establishing a radio communication system for direction of the patrol and maintenance crews on the transmission system, got stuck in a mudhole a few miles south of Phoenix. He was testing a portable, two-way radio set over which he notified the operator at the fixed station that he would have to sign off long enough to get out of the mud. Much to his amazement, when he was again rolling, the operators of the Soil Conservation Service station located just north of Tampa, Florida, contacted him directly through his portable set in the car. They told him that they had been listening to his trouble and had stood by to send out a power wagon to help him out of the hole. But they added, what amazed them was that there was sufficient water in Arizona to develop enough mud to stall a car. They said they were used to mud and had specially equipped "power wagons" to lend aid to bogged-down equipment.

Since meeting in the mudhole, the Bureau of Reclamation and the Florida crews have established direct communication between the two radio systems on several other occasions, both between fixed stations and between cars operating in the two States. At one time contact was lost between the Bureau's fixed station and a radio car testing between Yuma, Arizona, and El Centro, California. The car was "lost" behind the southeastern California sand hills known in this area as "The Hollywood Sahara." The directing station called Florida and the operator there contacted the test car and told it to return to Yuma.

It appears that the Soil Conservation Service in Florida has been assigned an operating frequency of 36.02 megacycles for dispatching its cars and the same frequency has been assigned to the Bureau for test purposes west of the one-hundredth meridian. While this short wave radio communication is considered satisfactory only when the receiving aerial is in sight of the transmitting aerial, actually the phenomenon of reflected waves frequently renders it effective over much greater distances. One of the Soil Conservation men commented that the Service had been sold the equipment with the understanding that it was "line-of-sight." There must be a straight tunnel between Tampa and Phoenix.

Operating under the understanding that such radio equipment is most effective and reliable when both the transmitting and receiving aerials are within sight of one another, the Bureau of Reclamation is planning to place automatic relay stations on strategic elevations and expects to obtain complete coverage of its far-flung Parker-Davis power transmission system so that patrol and maintenance crews will be constantly in contact with headquarters. In the wide open spaces of Arizona, where wire telephone communication is frequently non-existant, the use of two-way radio will reduce the time of power shut-down due to accident or emergency, promote safety for the maintenance men, and save far more than the cost of installation of the system. THE END

(Continued from page 142)

reservoir when full would be 886 feet above the average river level at the pumping plant. Automatic float-control valves at the reservoir would start and stop the pumps by means of a 28,500-foot electric control line. An independent automatic signaling system would further provide against overflow.

The Pumping Plant

Preliminary studies have shown that two pumping plants should be provided, a deep-well turbine plant to lift water from the river and a multistage centrifugal pumping plant to force the water to the high-lying project lands. Each pumping plant would be separately housed.

The river pumping plant is designed for the wide fluctuations in river elevations. The plant would consist of three 6,300-gallons per minute, 45-foot head, motor-driven, deep-well turbine pumps with 20″ discharge pipes, screened at the intake to protect fish life.

The main pumping plant would contain three 14-cubic feet per second, 900-foot head, horizontal, multistage, centrifugal pumps with bases and couplings. Prime movers would be three 2,000-horsepower, 1,800 revolutions per minute synchronous motors with exciters. Mechanical equipment would be 20″ discharge pipes with 4-way fittings, three 14″, 400-pound, gear operated, gate valves; three 14″, 400-pound, tilting-disk, check valves; and one 14″ Pelton surge suppressor.

Power for pumping would be obtained from the Bonneville Power administration. Project requirements coincide with the peak power production months when total power demand is at a seasonal low. Ample power is available during this period, and the law grants preference to power needs of public bodies. The Bonneville Power Administration has agreed in principle, contingent upon available funds and materials, to construct the necessary transmission line from their substation west of The Dalles to the pumping plant. The Administration would also provide the necessary substation for reducing voltage at the pumping plants.

Costs of the Project

Construction cost of The Dalles project, West Unit, has been estimated at $2,300,000. Operation and maintenance costs, including power costs and a reserve fund for replacements, are estimated at about $66,000 per year. Average annual costs over the 40-year repayment period without interest are about $123,500 or $27.30 per acre on the 4,530 acres. Payment of this cost for water out of $70 average per acre increased net farm income leaves $42.70, about half of which would provide a return of 5 percent of the increased farm investment. The other half would give farm operators a relatively high wage for the additional labor required with irrigation. The irrigators should therefore have no difficulty in repaying construction costs, if a flexible repayment contract based on crop income is adopted to insure against undue hardship in low income years. THE END

MEASURING

A MEASUREMENT, whether it measure space, force, time, or any other physical quantity involved in the engineering control of nature, can be no more accurate than the standard by which the measuring instrument is checked and adjusted.

As instruments used for routine measurements undergo normal wear and tear during their use, other instruments of extreme accuracy must be kept as primary standards for periodic check-ups and calibration of "tools of the job."

Laboratory data used by the Bureau of Reclamation must be reliable and accurate at all times. This is most important as the effective diagnosis and practicable solution of many of the Bureau's varied engineering problems depend upon intensive laboratory tests and studies. Thus the accuracy of laboratory gages and calibrating standards comes to the forefront when it is necessary to determine correctly, before construction starts, and before designs can be drawn, what quality of concrete should be used in a dam or canal, how to assure the efficient operation of gates and valves, and what would be the most economic design of other structures and operating equipment.

FOR ACCURACY

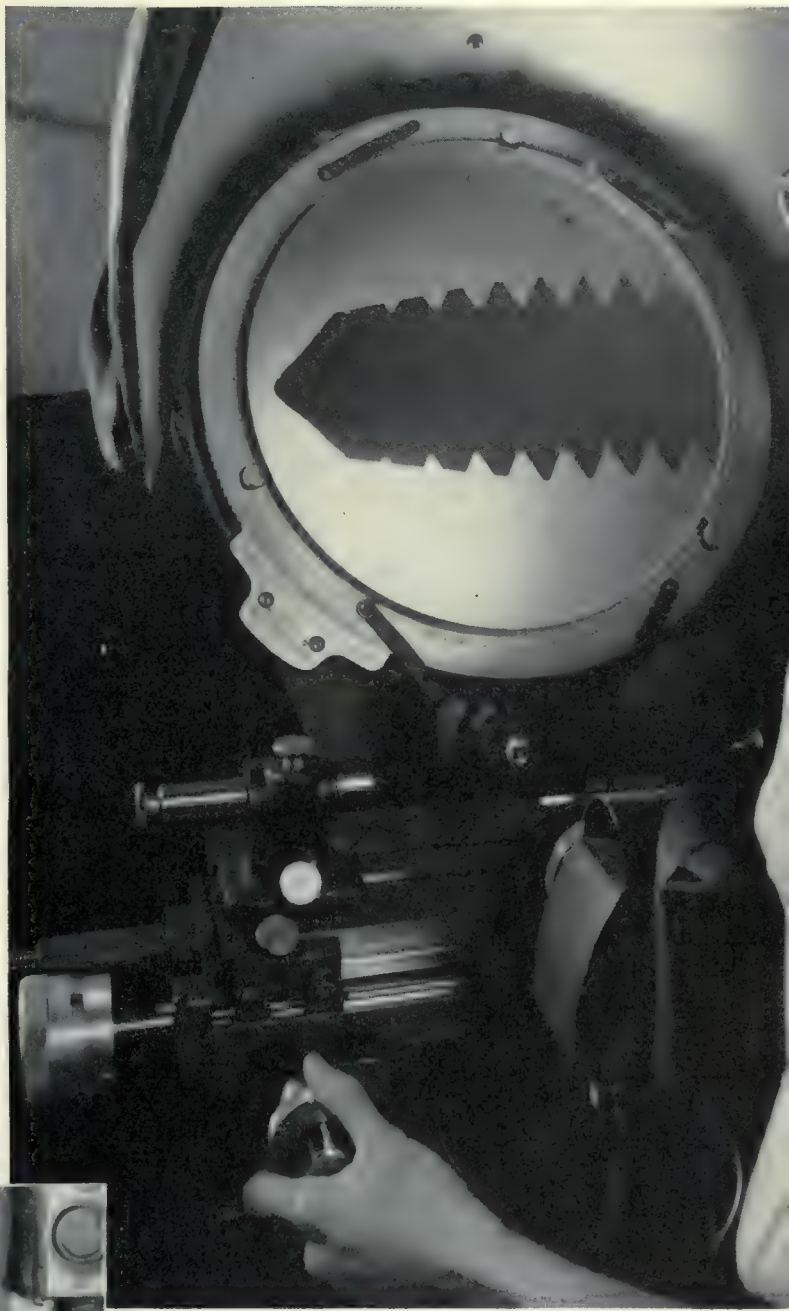
By LESTER D. ERB,
Engineer,
Branch of Design and Construction,
Denver, Colorado

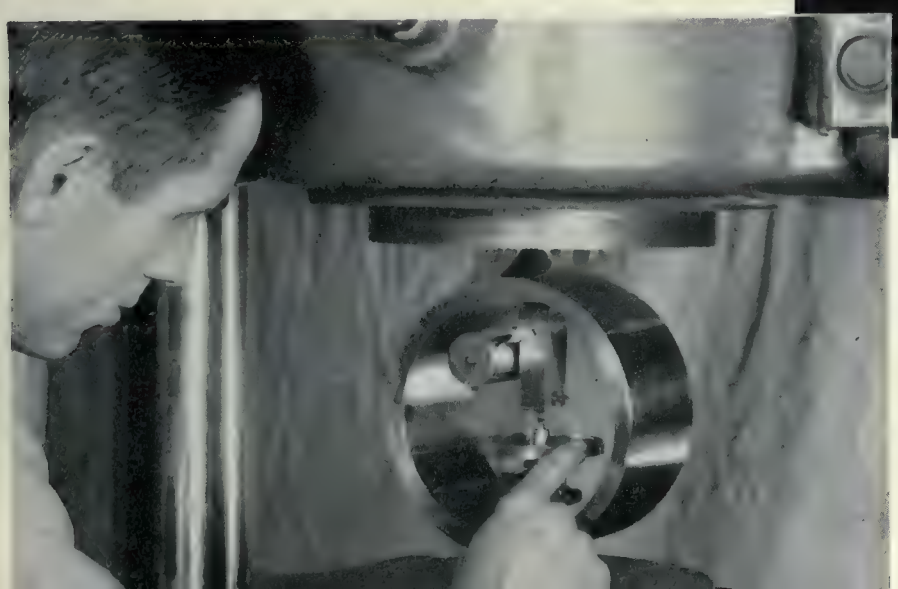
Typical of the varied types of calibrations is the periodic check of the compression testing machines. These machines are used to measure the compressive strength of concrete. It is possible for them to determine the strength and elasticity of a concrete mix for design studies and control the strength and uniform quality of concrete during construction. The testing machines are calibrated by the use of specially designed proving rings, each of which is accurately calibrated by the U. S. Bureau of Standards to give the ultimate in accuracy in pressure measuring instruments.

The Materials Laboratories are well supplied with equipment for measuring physical dimensions, such as the optical comparator which projects on a ground-glass screen a highly enlarged image or "close-up" of the article being measured. This device is very useful for measuring such irregular objects as thread gages, taps, screen gages, and other parts where micrometer measurement is insufficiently accurate, impractical, or impossible.

Where extreme measuring accuracy is required, such as for the calibration of micrometer calipers, micrometer operated instruments, dial indicators, determination of the flatness of surfaces, etc., the gage blocks and optical comparator are used. These primary standards have accuracies within four millionths of an inch of the specified dimension.

A wide variety of miscellaneous laboratory equipment is also calibrated in the laboratory, such as concrete elasticity testing fixtures, compaction machines, hydraulic presses, hydraulic and pneumatic pressure gages, and jacks, as well as instruments to measure the hardness of metals, rubber, and plastics, gas volumes and velocities, light intensities, and high temperatures. Thus a check, double-check, and even triple check is assured of all the complicated and vitally essential materials which go into the structures built by the Bureau for the reclamation of western lands. THE END





Extreme left: Accuracy of testing apparatus is determined by testing hardness of steel with that of other specimens of known hardness. Immediate left: Technicians measure deformation of proving rings under a wide range of loads to enable them to calibrate the compression testing machines to a fine degree of accuracy. Above: Angles of the cutting faces of the ¼-inch tap (center) are accurately measured on the enlarged image projected on the ground glass screen of the optical comparator.

"Bonifica" in Italy

(Continued from page 152)

where it is yielding much less than it should produce. In other cases, the large land owner farms the land himself either with day labor or by use of peasant share croppers. In this case the peasant probably does not fare much better than in the previous case, but there does exist more incentive to build up the land and farm facilities. In a number of cases, peasants have secured by purchase, by homesteading in undesirable, marshy or mountainous areas, or by other means, tiny areas on which they erect homes and eke out a bare living through an intensive type of agriculture. It is not unusual to see three "layers" of crops on the same land—

- small row crops
- olive trees or fruit trees, and
- grape vines, which are carried above or between the trees.

Such an intensive system creates a tremendous strain on the resources of the soil. Despite such intensive agriculture, the smallness of the typical peasant's farm usually makes it necessary for him to seek additional compensation by hiring out as day labor when he is not required to tend his own tiny holding. Because of the critical land shortage the peasant cannot leave the only land he owns and because he cannot earn a living on that small tract, he is in a very unsatisfactory bargaining position with the large owners with whom he seeks supplemental employment.

A solution to the land holding problem is very complex and would require a considerable amount of time to effect. I sincerely believe that the present government is very desirous of effecting land reforms. In fact, the Government has recently appointed a special Vice Premier who will spend the major portion of his time in working toward the solution of the agricultural problems in these areas. His task will be far from easy. Any plan of helping Italy necessarily includes the bringing into cultivation of large quantities of new land. Italian farm leaders look to reclamation as a way to adjust economic difficulties.

With the possible exception of Sardinia, as shown in the table on page 150, the entire areas are seriously over populated. In Sardinia the natives have been shepherds for years and changes in their mode of life must be gradual. Consequently, it is not expected that this country, which is very rugged in topography and not suited to intensive cultivation, will be changed very much in the immediate future, although efforts are being made to utilize every possible agriculture area to its fullest extent and to improve the type of agriculture being pursued. Before land reform, including the making available of family size farm units to the peasant, can be made fully operative, a program will have to be put into effect for improving the educational level of the peasants. Only thus can they learn to use modern farm equipment efficiently, and on their own initiative. Elementary education is also a necessary step in helping them to learn to do much of their own farm planning and marketing. Most of this work is now being done for them by the tenants or large land owners. Someone—perhaps someone corresponding to our county agent—is needed to lend a hand by serving as a readily available and continuous source of sound, practical advice to the farmer. When the Italian farmer learns to think for himself and to use modern machinery effectively he can add to his income by participating in small off-the-farm industry, thereby raising his standard of living.

There has been much discussion about emigration to help the over-populated situation. There is no doubt but what a large amount of immediate emigration would ease the critical crowded conditions, but such relief would be short-lived under present conditions. A better program for long-range planning would be to improve as much as possible the educational level of the individual peasant so that he can solve for himself many of the problems he faces. Continued emigration usually results in a loss to the country of those individuals who possess large amounts of vision, courage, resourcefulness and industry. No country can afford continually to lose people with these qualifications. It is like a farmer selling his seed corn because it draws a premium, and keeping his inferior corn to plant. No country can prosper long under such a practice.

There is no doubt but what drastic, immediate relief is necessary, but in obtaining this stop-gap aid, the longer over-all program should be kept in mind. THE END

From the Diplomatic Pouch

Termed "one of the most complimentary papers to be received through State Department channels" here are excerpts from an incoming telegram regarding the Italian mission in which American Ambassador to Italy James C. Dunn transmitted this unsolicited letter from Count Carlo Sforza, Minister of Foreign Affairs, De Gasperi Government of Italy:

My dear Ambassador:

With the departure of Messrs. McCall and Tomlinson, the first phase of Italian-American technical cooperation on the problems of South Italy is finished. Together we have laid the foundation for this cooperation and watched over its early development.

I wish first to express to the U. S. Government and to you personally, the hearty appreciation of the Italian Government for the arrival of these scientists. In addition, I must tell you that the choice couldn't have been better; Messrs. McCall and Tomlinson not only proved their known ability and experience in technical agricultural and hydroelectro problems, but also achieved a most satisfactory degree of cooperation with our technicians, upon whom they made an excellent impression in every way.

The report, presented at the end of their trip is really constructive and interesting. This report is now being carefully studied by the interested governmental bodies in the hope that a cooperative effort so well begun may take more definite form as soon as possible.

I need not repeat my conviction that the solution of our southern problems will contribute in no small way to definite politico-economic balance in Italy, something which I am sure, will be a solid guarantee for social stability in this vital Mediterranean sector.

As soon as I have the opinion of the various other branches of the government I shall discuss this question again with you in order that we may achieve the goals which we have discussed for some time.

Please accept every expression of my warmest regards,

Sforza.

RATS ARE ROBBERS

by DORR D. GREEN,

Chief, Branch of Predator and Rodent Control, U. S. Fish and Wildlife Service, United States Department of the Interior

Rats are rubbing their paws with greedy delight—the harvest which is being stored away in the Nation's barns this fall will provide an easy feast for them. If humans are as careless as they have been in the past, the rats can count on gorging on two-hundred million bushels of grain this year, almost half the grain needed to send to starving Europe.

The 150,000,000 rats in the United States shouldn't brag too soon about the coming harvest for them. This year, all over the country, the farmer and the city-dweller are mobilized in the National Rat Control Campaign to stop the $2,000,000,000 anual thievery of these expensive pests. The Fish and Wildlife Service of the U. S. Department of the Interior, and the Department of Agriculture are working together to save every morsel of food from the rats to help feed the hungry world. This campaign, part of the President's emergency food conservation program, is sparked by the National Committee for Rat Control, whose chairman is Hamilton M. Warren, vice president of the National Carbon Company, New York City.

Getting rid of rats may seem like a hopeless job to many farmers. There are so many sources of food, so many places for rats to make their homes. Where does one start? Actually, a rat-proofed farm is not necessarily one where every kernel of corn has a day and night guard against rats. A rat-proof farm however, must provide such uncomfortable living conditions for rats that they will move to greener pastures or can be easily destroyed by the farmer.

Surprisingly, the most basic step in getting rid of rats on the farm is simply good housekeeping. Keep the farm neat, and it will not only look like a farm journal picture, but it will have few rats.

Don't let any of the refuse from the house lie around, for it will attract rats. Provide incinerators for burnable trash and garbage, deep covered pits with trap doors for tin cans, and a garbage can with a tight lid, if table scraps are not fed directly to poultry or hogs.

On the rest of the farm, make sure that there are no piles of materials which supply "Home with Eating Facilities" to rats. Lumber or other usable materials piled on sawhorses or on platforms 18 inches above the ground will be unattractive to a home-hunting rat. While rats like to live in piles of cut stove wood, manure or hay within walking distance of food, they are easily discouraged if you move these home-sites to some distance from the granary, house or other building where food is handled.

Stone walls and ditches also are often a source of rat in-

At left: Stack of lumber carelessly piled on the ground provides an ideal "rats' retreat." At right: This creature and its kinfolk cost the U. S. about two billion dollars a year. ***Both photos courtesy U. S. Fish and Wildlife Service, by John C. Jones.***

festation, and unlike the previously-named harborages, cannot be easily moved away from food. The inviting openings in stone walls however can be closed easily with cement. Destroying the protective vegetation on the ditch banks near buildings will give the sensitive rat a good healthy fear, but it must be repeated often.

After the entire farm is tidied up so no rats are living comfortably outside, it is time to look at the buildings. A good, solidly built building is usually a good rat-proof building. For example, rats seldom burrow deeper than 2 feet in the ground, so a building whose foundation extends well into the ground below the frost line automatically keeps the rats from digging under the floor. Concrete foundations should also extend a foot or more above the ground to keep the rats from sneaking up behind a bush to gnaw through the wood siding.

Old buildings with dirt floors and without concrete foundations may be ratproofed by adding a two foot concrete curtain wall and a concrete floor or by raising the building on concrete posts to a height of at least 2½ feet off the ground. No matter what method is used, precautions must also be taken not to pile materials around or under the building and thus provide stepladders to help the rats over the ratproofing.

Ratproofing all the buildings with concrete, sheet metal or hardware cloth is the only sure way of permanently excluding rats. It may seem like too large an expenditure, but compared with the $20 each rat on his farm costs the farmer annually, it is cheap. In one year, the cost of ratproofing the buildings will be completely repaid by the amount of foodstuffs saved, the United States Fish and Wildlife Service rat control experts estimate.

Remember the Corn Crib

Of all the buildings on the average farm, the corncrib needs the greatest amount of work to protect the harvest from rats. Surveys of farmers' losses of corn stored through the winter have found as high as one-fourth of the corn eaten or destroyed by rats. The amount of this loss would have been sufficient to pay for ratproofing the crib several times over.

While the most satisfactory way to ratproof a crib is to cover entirely the walls, ceilings, and floors with woven wire mesh, three meshes to the inch, there is a cheaper way. The same wire mesh can be used to cover the floor and walls to a height of two feet where the mesh can be fastened with a strip of galvanized iron 8 inches wide. Because the rats cannot gain a footing on the smooth metal to climb over it, the wire mesh need not be used above the iron strip. In any case, the wire mesh should be smoothly and firmly fastened and must be carried around both sides of doors and door jambs. Doors should be provided with closing springs or weights to make sure that after a thorough ratproofing job, the rats don't simply walk through the open door!

The granary is equally important in ratproofing the farm. Small wooden or portable granaries should be protected with wire mesh in the same way the corn crib was made ratproof. In the larger granaries with concrete foundations and floors, check to make sure that the ventilators are screened and that rats cannot come in through the elevator pit.

It is seldom possible to shut rats completely out of the barn or wherever livestock is fed. However, if rats' nests and runs are eliminated and the food is not handled carelessly, the rat population will start looking for a better home.

Besides stopping rats outside with concrete floors and ratproof foundations, the farmer must also check his barn walls. A hollow wall is nothing more than a safe retreat and a convenient runway leading to the haymow and home. Hollow walls should either be ripped out or filled to a height of 10 inches above the sill with cement. If the wall runways are eliminated, and all other rat harbors destroyed, the haymow will lose its attraction for rats.

The grain bin should be completely lined or covered with metal and should have metal-lined lids. Any open spaces behind or under the bins should be tightly closed with metal. Concrete feeding floors, troughs, water tanks, hog wallows and similar structures should be constructed with a curtain wall extending 2 feet or more into the ground to keep rats from burrowing under the slab.

The poultry house is another building difficult to ratproof, yet a place where the farmer can suffer a huge loss to rats. One poultry man reported that rats caused the loss of 80 dozen eggs within a week. Here, too, is another building which must have a ratproof foundation and no hollow walls. If warmth is necessary, sheathing and siding with a layer of building paper between, and tar paper sandwiched by double flooring will do the trick without encouraging rats. Nests should be raised 2 feet above the floor and feed and grit hoppers at least 1 foot. Drinking vessels for water and skim milk should be supported on a platform 1 to 1½ feet above the floors. Because rats feeding on poultry often have their homes as far away as 100 feet, nearby buildings must also be ratproofed.

After the farm is thoroughly ratproofed, the farmer can then turn to methods of killing off the rats. It is the least important method of rat control, however, for without ratproofing the rats will return twice as strong within 6 months. If it is decided to use poison, the only safe poison to use around livestock is red squill. However, it should be carefully controlled and each bait uneaten by the rats should be picked up the next morning.

A good rat dog can keep a rat-proofed farm free from rats. Other natural enemies of the rat which should be encouraged by the farmer are hawks and owls. The killing of these birds should be limited to those actually caught preying upon the poultry, and the others, should be left to their work of reducing the number of rats.

The rat control job on an individual farm of necessity extends beyond the property line. Because rats are no respectors of fences or "No Trespassing" signs, they will keep invading a rat-proofed farm as long as its neighbors maintain a growing rat population. Get together with your neighbor in a concerted anti-rat drive.

Fighting rats is a year-around, continuous job, but at no time is it more important than at harvest time. What counts is the amount of grain sold or used during the winter not the amount originally stored and then ruined by rats. The ratproofed farms in each county in the United States invariably are the more prosperous farms. A rat-proofed farm is proof that the farmer isn't going to let any possible profit be stolen away from him. Rat control is good farming and a good investment.

THE END

News Round-Up

Water from Mexico Aids American Farmers

Mexico has proved a good neighbor to the Rio Grande Valley again by releasing an additional 500 cubic feet a second of water from Marte R. Gomez Reservoir, President A. L. Cramer of the Valley Water Conservation Assn. said recently.

Mexico is providing more than half of the Valley's water supply by releasing it from her reservoir storage, he said. River flow at Rio Grande City is about 900 second-feet and the Mexican release is about 1,000.

"Demand for irrigation water in the Valley is a little more than 2,000 cubic feet a second," he added. "If it were not for the generosity of our neighbors, we would be in a critical situation."

Davis Dam Power Allocated

Secretary of the Interior J. A. Krug has authorized the Bureau of Reclamation to negotiate contracts for selling Davis Dam power in accordance with allocations which will supply the most urgent needs for power first. The three States which will benefit are the power-short areas of Arizona, California, and Nevada.

Applications for more than four times the capacity of the Davis Dam power plant have already been received. The basic allocations, which take into consideration fulfillment of commitments in presently existing Parker Dam power contracts will provide about 50 percent of the 180,000 kilowatt capacity for use in Arizona, and 25 percent for California and Nevada each.

Applications for more than 600,000 kilowatts were received from four States, with Arizona requesting most—approximately 322,000 kilowatts. As previously stated, allocations were based first on fulfilling Parker Dam power and other Colorado River commitments. Next, power allocations were made to Federal Agencies in the Department of the Interior and other Federal Agencies. Next in line for consideration were certain small contractors having preference under Reclamation Law now supplied power from Parker Dam, and finally other applicants having preference under Reclamation Law.

1947 Reclamation Crops Mark New High

Four and one-half million acres of farm lands, in cultivation last year on Federal Reclamation projects utilizing either full or partial water supplies from Bureau of Reclamation, constructed facilities, produced a gross crop value of $555,420,804, for a new record high.

The 1947 crop value was $24,796,859 greater than in 1946, when Federal Reclamation projects also surpassed the half-billion-dollar mark in production of food for the Nation.

The average return per acre in 1947 was $121.95, compared with $120.69 in 1946.

Commenting on the new record, Reclamation Commissioner Michael W. Straus said:

"Soundness of reclamation development of the Western arid lands cannot be better demonstrated, I believe, than by this annual gain in national well-being that is made possible by bringing irrigation water to the dry, fertile soils of the West. In the three years of 1945, 1946, and 1947, the gross crop values realized on federally served irrigated lands was greater than the total reclamation expenditures by the Federal Government since 1902, when the Reclamation Act was passed. Since 1906, when the first record of crop production on a Federal project was reported, more than 5½ billion dollars worth of crops have been produced on the lands these projects serve. And under the reclamation laws, which are designed to create family farming opportunities for the people, the cost of irrigation and hydroelectric-power construction is being repaid to the Federal Treasury by the water users and from power-sale revenues."

The irrigable acreage in 1947 was 5,166,789, an increase of 15,952 over 1946. This is the total area for which the Bureau of Reclamation was prepared to supply irrigation water.

Of the 37 projects which received a full water supply from Federal works, the Okanogan project in the State of Washington reported a 1947 per acre gross crop return of $398.18. On the Yakima project in the same State, the Tieton Division had a crop return of $509.87 per acre. Both of these areas are devoted largely to apple production.

Report on International Commission

The purpose of the Third International Congress on Large Dams, which met at Stockholm, Sweden, June 10–17 this year (see July 1948 ERA) was to discuss recent developments in the building of large dams. Invitations were issued to the twenty governments which are members of the International Commission on Large Dams with approximately 300 engineers in attendance.

Dams higher than the Hoover (Boulder) Dam, the highest in the world, are now being planned in both Europe and India. The Congress will contribute materially in the development of techniques which will make the construction of such dams practical. The Congress also discussed experiences arising from the testing and the actual use of special cements for large dams. Other topics considered related to uplift pressures and stresses arising therefrom, research methods and instruments for the measure of stresses and deformation in earth and concrete dams, and the most recent measures taken to avoid piping through dams.

The first two days of the Congress were devoted to the presentation of reports and to discussions, while the following 5 days, were spent on a study tour of a number of dams and hydro-electric power plants, and of one of Sweden's large industries. Some of these dams functioned north of the

Arctic Circle, and former Chief Engineer Walker R. Young, carried on his inspection at midnight, in the full daylight of the Midnight Sun.

The First Congress was held at Stockholm in 1933, simultaneously with the Sectional Meeting of the World Power Conference. The Second Congress was held at Washington, D. C., in 1936, simultaneously with the Plenary Meeting of the World Power Conference.

The International Commission on Large Dams, which arranges for the Congresses, was constituted in 1928 for the purpose of promoting research in matters connected with large dams and of collecting experiences in regard to their design, construction, maintenance, and operation. The member nations of the Commission function through national committees. The United States Committee on Large Dams is headed by Michael W. Straus, Commissioner, Bureau of Reclamation, Department of the Interior, whose paper "Global Hydro-Economics—A World Survey" was presented at the Congress.

Sacramento Salmon Resettled

(Continued from page 144)

to the Foster plan. But by 1945, it appeared that many fish preferred to stay and spawn in the Sacramento River, where temperatures were lower than in the creeks. By 1947, it was clear that water temperatures in the Sacramento, which both Mr. Foster and the consultants had believed would be too high to hold fish over summer, were practically ideal.

To utilize the river for spawning, plans were changed. In 1947, upstream migration was stopped at the Anderson-Cotton-wood Irrigation Dam in Redding. Thus blocked, the fish just drifted downstream to await the time of their bilogic mission in the large cool pools supplied by water from Shasta lake, apparently well contented with their new "home." As a result, the Sacramento River, from Redding 50 miles south to Red Bluff, now serves as a huge salmon nursery. A nursery capable of accommodating the entire run, even though the estimated number of fish is now 100,000, four times the number contemplated in the Foster plan. (The increased estimate is due not to an increase in the number of fish, but to improved counts made possible by the Balls Ferry "rack" and the Keswick fish trap.)

The original pessimism that water temperature below Shasta Dam would be too high for salmon has, for years of normal water supply at least, been dispelled. Trapping and hauling of fish has been discontinued. With only four years of operation, the life cycle of but one salmon run, optimism regarding the success of the program in its altered form must still be tempered with some qualifications. But there is good cause for optimism.

Even the 1942 run, whose migration was hampered by construction at Shasta Dam, but not aided by the salvage plan, must have spawned successfully. For the 1946 commercial catch—progeny of the 1942 run—of 6,462,050 lbs. in the Sacramento-San Joaquin Rivers was the largest in 21 years of record.

The 1947 catch of 2,323,926 lbs. was just about average. Although, to date, the Upper Sacramento River Salmon Maintenance Program appears to have compensated for the lost spawning areas, a cycle of dry years must be experienced, and the full operation of Shasta Dam achieved, before the success of the program can be fully evaluated.

Meawhile, the modifications in operation of the plan which have been made because of low stream temperatures, will make the program much less costly. Mainly, by eliminating the need to transfer the spring run from the main river to Battle Creek and Deer Creek, thus making operation of the Keswick and Balls Ferry fish traps unnecessary. These traps must, however, be held in standby condition for future use. For a very dry year with high water temperature might make it necessary to move the fish. Or Mother Nature might pose some new problem which no one has foreseen. Operation of Coleman Hatchery will probably have to be continued, to propagate the fish relocated in Battle Creek from 1943–46.

Under cooperative arrangement with the Bureau of Reclamation, the Fish and Wildlife Service is continuing to observe water temperatures, and to estimate fish population and success of natural spawning. Important lessons regarding fishery management are being learned, lessons which should be of great value in building future water-control projects on Pacific Coast streams.

Meanwhile, the modifications in plan have not only resulted in reduced operating cost of the program, but if natural spawning is more efficient than artificial propagation, more fish have been produced. And, if salmon can be induced without much trouble to change their ancestral spawning grounds, the problem of reconciling the fish industry with farming—an area of bitter conflict—will have been changed to one of whole-hearted cooperation in the best development and use of the limited Western water resources. THE END

_____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

Sincerely,

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(Name and address of association)

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(Name)

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NOTES FOR CONTRACTORS

Contracts Awarded During June 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2101	Columbia Basin, Wash.	June 7	10 disconnecting switches for Grand Coulee switchyards, schedule 2A.	Schwager-Wood Corporation, Portland, Oreg.	$71,129
2113	Hungry Horse, Mont.	June 16	Four governors for Hungry Horse power plant, schedule 2.	Woodward Governor Co., Rockford, Ill.	121,600
2116	Davis Dam, Ariz.-Nev.	do	Construction of 34.5 kilovolt transmission lines for Yuma area.	J and J Construction Co., Oklahoma City, Okla.	65,132
2127	Boise, Idaho	June 2	Construction of relocated reservoir road at Anderson Ranch Dam.	Hoops Construction Co., Twin Falls, Idaho.	341,133
2131	Columbia Basin, Wash.	June 8	Electric heaters for Grand Coulee right power plant.	Coates Electric Manufacturing Co., Seattle, Wash.	41,599
2138	Missouri Basin, Mont.	June 4	Furnishing and erecting 14 prefabricated residences for Moorhead government camp, schedule 5.	Lewis Construction Co., Billings, Mont.	148,574
2144	Davis Dam, Ariz.-Nev.	June 7	Steel structures for Parker switchyard extensions.	Allison Steel Mfg. Co., Phoenix, Ariz.	56,513
2147	Boise, Idaho	June 4	Clearing Anderson Ranch reservoir site.	W. D. Zavalas, Oroville, Calif.	115,328
2155	Klamath-Tule Lake, Oreg.-Calif.	June 17	Two pumping units for pumping plant D.	Worthington Pump & Machinery Corporation, Harrison, New Jersey.	49,433
2166	Central Valley, Calif.	June 15	Construction of 69 kilovolt transmission line from Contra Costa substation to Clayton and Ygnacio pumping plants.	George Pollock Co., Sacramento, Calif.	136,728
2176	Davis Dam, Ariz.-Nev.	June 29	Carrier-current telephone apparatus, coupling capacitor potential devices, and carrier-current line traps for Davis Dam and Parker Dam power systems.	General Electric Co., Denver, Colo.	222,000
2182	Columbia Basin, Wash.	June 8	Control boards for units R4, R5, and R6, Grand Coulee power plant; and 230 kilovolt Columbia lines 3 and 4, and Snohomish Line No. 1.	Westinghouse Electric Corp., Denver, Colo.	60,312
2187	Davis Dam, Ariz.-Nev.	June 15	Two air break switches for Davis tap to Hoover-Basic Magnesium line.	Pacific Electric Manufacturing Corporation, San Francisco, Calif.	16,375
2191	Klamath-Tule Lake, Oreg.-Calif.	June 25	Construction of earthwork and structures for Lost River Channel improvement, Poe Valley.	J. A. Terteling & Sons, Inc., Boise, Idaho.	91,730
2192	Columbia Basin, Wash.	June 16	Nine 230,000 volt lightning arrestors for Grand Coulee 230 kilovolt right switchyard.	Westinghouse Electric Corporation, Denver, Colo.	24,195
2197	Central Valley, Calif.	June 30	Construction of earthwork, concrete lining, and structures for Delta-Mendota Canal.	Morrison-Knudsen Co., Inc., and M. H. Hasler, Los Angeles, Calif.	4,418,811
2201	Missouri Basin, S. Dak.	June 8	Construction of earthwork, structures, and surfacing for access road at Shadehill Dam.	Fogg and Holzworth Construction Co., Miles City, Mont.	10,741
2206	Provo River, Utah.	June 28	Construction of tunnels 1, 2, and 3, Salt Lake aqueduct.	United Concrete Pipe Corporation, Baldwin Park, Calif.	439,330
2210	Hungry Horse, Mont.	June 16	Two traveling cranes for Hungry Horse Dam and power plant.	Moffett Mfg. Co., Albany, Calif.	42,215
2211	W. C. Austin, Okla.	June 16	Installing radial gates and spillway bridge at Altus Dam.	Stebbins-Frost Construction Co., Tulsa, Okla.	70,935
2212	Columbia Basin, Wash.	June 2	60,000 barrels of bulk portland cement for construction work in vicinity of Coulee Dam and Odair, Wash.	Superior Portland Cement Inc., Seattle, Wash.	161,400
2212	Columbia Basin, Wash.	June 2	40,000 barrels of bulk portland cement for construction work in vicinity of Coulee Dam and Odair, Wash.	Permanente Cement Co., Oakland, Calif.	122,000
2214	Missouri Basin, S. Dak.	June 30	Clearing part of Angostura reservoir site.	Schutt Construction Co., Inc., Genoa, Wis.	24,551
2217	Tucumcari, N. Mex.	June 28	Construction of earthwork and structures for Conchas Canal; lateral unit 6; and construction of bridge at Conchas Canal.	J. A. Terteling & Sons, Inc., Boise, Idaho.	918,029
2219	Hungry Horse, Mont.	June 25	Construction of dormitory, office annex, ten-car garage, and 20 residences for Hungry Horse government camp, schedule 1.	Askevold Construction Co., Inc., Missoula, Mont.	468,270
2225	Columbia Basin, Wash.	June 16	Six 12-by-18-foot radial gates for Main Canal headworks at South Coulee Dam.	American Bridge Co., Denver, Colo.	55,563
2243	Hungry Horse, Mont.	June 15	1,250,000 barrels of bulk portland cement for construction of Hungry Horse Dam.	Lehigh Portland Cement Co., Chicago, Ill.	4,000,000
2243	do	do	625,000 barrels of bulk portland cement for construction of Hungry Horse Dam.	Spokane Portland Cement Co., Spokane, Wash.	1,812,500
2243	do	do	do	Ideal Cement Co., Denver, Colo.	2,062,500
2246	Missouri Basin, Wyo.	June 23	Furnishing and erecting 10 prefabricated residences for Keyhole government camp.	Bredina Construction Co., Rapid City, S. Dak.	94,300
2258	Colorado-Big Thompson, Colo.	June 29	Materials for steel warehouse at Wild's Spur (Loveland), Colo.	American Bridge Co., Denver, Colo.	31,411
2284	Missouri Basin, S. Dak.	June 25	132,500 barrels of bulk portland cement for construction of Angostura Dam.	Universal Atlas Cement Co., Chicago, Ill.	324,625
2300	Davis Dam, Ariz.-Nev.	June 29	Three 30,000 kilovolt-ampere transformers for Phoenix substation.	Allis-Chalmers Mfg. Co., Denver, Colo.	445,000
R1-15	Boise, Idaho.	June 18	Construction of pumping plant and pipe line for Cascade, Idaho.	Intermountain Plumbing Co., Boise, Idaho.	12,482
R5-3A	Rio Grande, N. Mex.-Tex.	June 24	Paving camp roads at Elephant Butte Dam.	D. D. Skousen, Albuquerque, N. Mex.	31,678
BHD-50-B	Missouri Basin, Wyoming.	June 7	66,250 barrels cement for Boysen Dam.	Monolith-Portland Midwest Co., Denver, Colo.	406,881
R6 RP-12	Riverton, Wyo.	June 15	Preparation of concrete aggregates at Krump deposit.	Gilpatrick Construction Co., Riverton, Wyo.	94,580

Construction and Supplies for Which Bids Will Be Requested by October 1948

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Generators and power transformers for units A3 and A4 at Hoover power plant.
Colorado-Big Thompson, Colo.	Construction of 1,500 kilovolt-ampere Fleming substation near Fleming, Colo.
Do	Construction of 500 kilovolt-ampere Haxtun substation near Haxtun, Colo.
Do	Construction of 115 kilovolt transmission lines from Estes power plant to Marys Lake power plant and from Estes power plant to Granby pumping plant.
Do	Construction of earthwork, lining, and structures for 8 miles of Horsetooth Feeder Canal, including 11 concrete siphons, one steel siphon, and other structures near Loveland, Colo.
Columbia Basin, Wash.	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 8 miles of Winchester wasteway near Winchester, Wash.
Do	Generators for units R7, R8, and R9, Grand Coulee power plant.
Do	Transformers for units R7, R8, and R9, Grand Coulee power plant.
Do	Generator for station service unit LS-3, Grand Coulee power plant.
Do	Transformers for station service unit LS-3, Grand Coulee power plant.
Do	Wire, insulators, copper tubing, oil circuit breakers, and disconnecting switches, for station service unit LS-3 tie circuit, Grand Coulee power plant.
Do	Additions to 6,900 volt switchgear XLS, Grand Coulee power plant.
Do	Construction of North Dam, an earthfill structure which is to form the north barrier of the Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 14.5 miles of East Low Canal; construction of about 6.5 miles of Rocky Coulee wasteway; in vicinity of Moses Lake, Wash.
Davis Dam, Ariz.-Nev.	CO_2 fire protection equipment for Davis power plant.
Kendrick, Wyo.	Control board for Hanna substation.
Klamath, Calif.-Oreg.	Rehabilitation and extension of laterals and drains near Tule Lake, Calif.
Do	Radial gates and hoists for Lost River diversion channel.
Lewiston Orchards, Idaho	Construction of earthwork, structures, and pipe lines for domestic and irrigation water distribution system.
Missouri Basin, Colo.	Construction of Bonny Dam, an earthfill structure, on the South Fork of the Republican River near Hale, Colo.
Missouri Basin, Kans.	Construction of Cedar Bluff Dam, an earthfill structure, about 136 feet high and 12,570 feet long, on the Smoky Hill River, near Ellis, Kans.
Missouri Basin, Nebr.	Radial-gate hoists for Enders Dam.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior, Nebr.
Missouri Basin, S. Dak.	84-inch outlet pipe for Shadehill Dam.
Do	Construction of Shadehill Dam, an earthfill structure, on the Grand River about 20 miles south of Lemmon, S. Dak.
Missouri Basin, Wyo.	Power circuit breakers and disconnecting switches for Boysen switchyard.
Do	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Keyhole government camp about 18 miles northeast of Moorcroft, Wyo.
Do	Construction of about one mile of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Paonia, Colo.	Enlargement of about 4 miles of Fire Mountain Canal, from its present capacity of 70 cubic feet per second to a capacity of 200 cubic feet per second, located near Somerset, Colo.
Provo River, Utah.	Construction of Duchesne tunnel from station 5+10 to station 199+48, and construction of a diversion dam on the North Fork of the Duchesne River about 24 miles east of Heber, Utah.
Do	Construction of Murdock Diversion Dam, Canal, and tunnel lining at the head of the Provo Reservoir Canal near Provo, Utah.
Parker Dam Power, Davis, Dam, and Boulder Canyon, Ariz.-Calif.-Nev.	Telemetering and supervisory control equipment.

The Colorado River

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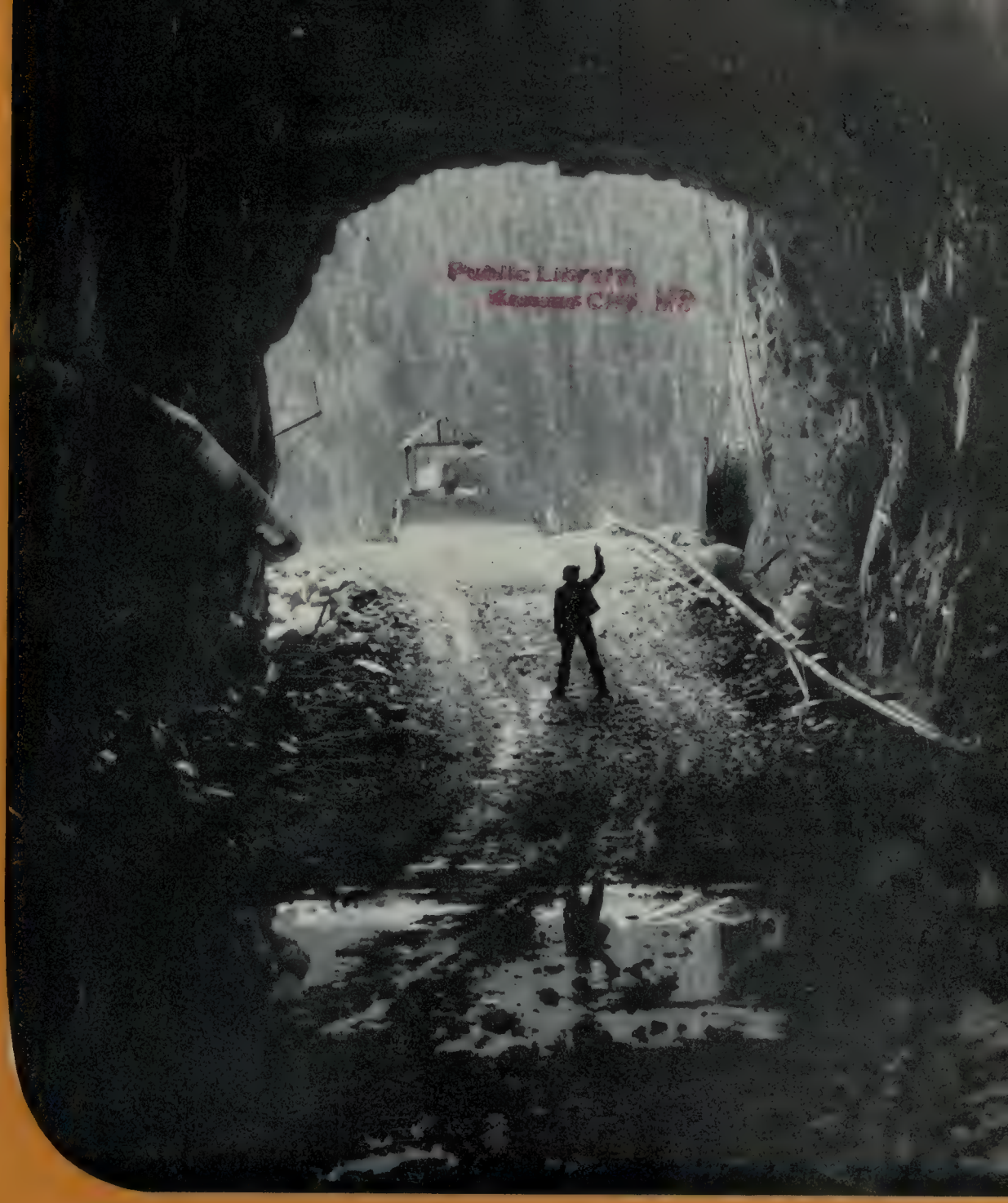
SEPTEMBER
1948

In This Issue:

The Urban Benefits of Irrigation
by Ned O. Thompson

Deep-Sea Diving In the West

Taking a Poke at Poison Oak
by J. W. Koehler



THE Reclamation ERA

Reclamation Place Names in This Issue

Want a Waterweed Killer License?

Many commercial firms have requested information on preparing and dispensing a chemical formulation discovered to be of value in controlling waterweeds by personnel of the Bureau's Chemical Engineering Section of the Chief Engineer's office in Denver and the Bureau of Plant Industry, Soils and Agricultural Engineering. An article entitled "A New Killer for Waterweeds," by W. T. Moran and J. M. Shaw, discussing the use of the chemical compound, which is a solvent naphtha, appeared in the May issue of the RECLAMATION ERA.

The Department of the Interior has applied for a patent on the material for use as an aquatic herbicide.

Those interested in obtaining a license for the use of patents held by the Department should file directly with the Solicitor of the Department of the Interior, Washington 25, D. C., an application stating:

(1) the name, address, and citizenship of the applicant;
(2) the nature of his business;
(3) the patent or invention upon which he desires a license;
(4) the purpose for which he desires a license;
(5) his experience in the field of the desired license;
(6) any patents, licenses, or other patent rights which he may have in the field of the desired license; and
(7) the benefits, if any, which the applicant expects the public to derive from his proposed use of the invention.

Reclamation ERA

September 1948 **Vol. 34, No. 9**

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Ruth F. Sadler, Editor

OUR FRONT COVER

"Glory Road" at Hungry Horse

Downstream view of the 1,100-foot-long diversion tunnel now being drilled through the right abutment at Hungry Horse, Mont. During construction of the Hungry Horse Dam the entire flow of the South Fork of the Flathead River in northwestern Montana will be diverted through this tunnel. The portion of the tunnel shown here will eventually become part of the discharge end of the "glory hole" spillway. This photo taken by Stanley Rasmussen, Region 1, Boise, Idaho.

The Urban Benefits of Reclamation

The people of the town of Yuma, Ariz., show how town and country benefit from reclamation development, and raise the question, "Should the farmer foot the entire bill for irrigation projects?"

by NED O. THOMPSON
Branch of Operation and Maintenance, Region III, Boulder City, Nev.

THE STRANGER EMERGED FROM A TRACKLESS DESERT of sagebrush and cacti and entered a lush green valley of growing crops. Men with tractors were at work planting some fields, harvesting others. Livestock grazed in alfalfa. Highways were crowded with trucks hauling produce to market. Farther along was a modern city of paved streets, beautiful homes, and buildings. Sidewalks were thronged with people going in and out of stores and banks.

The dollar was having a busy day.

"What is responsible for all this industrial activity?" the stranger asked a passerby. "Irrigation," was the reply.

From the beginning of time, civilization in the arid regions of the world has flourished around the water holes. The same is true today in the dry West where more than 4 million acres of land now being irrigated by Bureau of Reclamation facilities have created wealth locally and throughout the Nation.

For irrigation benefits go much beyond the farm. They are shared by merchants, transportation systems, manufacturers, laborers, and all business people, particularly in irrigated areas. However, the farmer generally foots the Reclamation bill except when part of the costs are borne by hydroelectric power revenues, or charged off to flood control and other such benefits.

As a general rule projects that have major power or flood control features are not difficult to justify under existing Reclamation law. On the other hand, projects without a helping hand from power or flood control experience difficulty in demonstrating reimbursability of funds advanced for their construction. This is particularly true in this day and age when most of the easy projects already have been constructed.

But how about the benefits which accrue as a whole to the Nation, from an irrigation project? Expenditures for construction provide employment and profit to individuals and business firms located in various parts of the country. Likewise, an expansion in irrigation extends the market for farm machinery, fertilizers, and other supplies used by farmers which may be manufactured at considerable distance from the project area. Other Nation-wide benefits include lower food prices that may result from the development, especially in periods of scarcity; additional quantities of food, the need for which is evident particularly in wartime and other periods of national emergency; and more stable food production with less likelihood of crop failures from droughts, which have a disrupting effect on the Nation's economy.

SILVER DOLLARS ON THE HORIZON—Canals like this interlace the Yuma project so that desert soils may drink and produce. As in hundreds of other irrigated areas, the Yuma project has created a lasting economy for surrounding towns and has benefited industry throughout the Nation. ***Photo by Harry W. Myers, Region III.***

It also can be demonstrated that the Federal Government over a period of years receives a return on its investment in irrigation projects through increased revenues in the form of taxes that may exceed by many times the original cost of construction. In passing the original Reclamation Law of 1902, the Congress recognized the benefits accruing to the Nation as a whole from irrigation development by requiring repayment of construction costs without interest and later providing for a development period of up to 10 years prior to initiating repayment. At present interest rates charged for borrowed capital, it may be shown that the Government, by providing interest free money and deferring repayment of capital costs for 10 years, is contributing 35 to 40 percent of the total investment in irrigation works.

In recognition of the fairly direct benefits of Reclamation to business concerns in nearby towns, the House Appropriations Committee, Eightieth Congress, first session, requested the Bureau of Reclamation to compile information on the relation between irrigation development and growth in project towns and related business activity. The Yuma project, located in the southwest corner of Arizona and the southeast corner of California, was selected as one of several projects to illustrate the urban development associated with irrigation farming. An examination of the growth in population and

Workers harvesting cantaloupes in the Yuma Valley for markets throughout the Nation. Last year this crop brought over $2\frac{1}{2}$ million to project growers. *Photo by Harry W. Myers, Region III.*

Livestock exhibit in downtown Yuma, Ariz., draws large crowd. Sales of livestock for the project during the last year amounted to approximately $2\frac{3}{4}$ million. *Photo by Samuel B. Watkins, Region III.*

business in the Yuma area will serve to illustrate the propriety of shifting a portion of the irrigation repayment to local nonfarm interests.

Without irrigation, farming would be impossible in the Yuma area, since rainfall averages only 3 to 4 inches annually. There is little mining or other basic industry providing employment or trade in that vicinity. Except for some tourist business the entire urban economy is dependent on irrigation farming.

The Yuma project comprises only 69,000 acres of irrigable land. Some irrigation was being practiced by direct diversion from the Colorado River prior to the construction of the project in 1905–10 by the Bureau of Reclamation. At present the water is diverted from the west side of the Colorado River at Imperial Dam, with the water required for lands located on the Arizona side of the river siphoned under the Colorado at the city of Yuma. Irrigation is by gravity except for about 2,000 acres which require a pump lift of 70 feet. The main crops grown are alfalfa, flax, feed grains, lettuce, cantaloupes, carrots, other winter vegetables, and citrus fruits. Yuma, Ariz., is the main town located on the project; other small towns are Somerton and Gadsden in Arizona, and Bard and Winterhaven in California. The net cost of constructing the project, not including interest on Treasury funds, amounted to about $9,700,000.

In 1910, there were 9,000 acres cropped on the Yuma project. This was the first year that gravity water was available from the project system. The acreage irrigated increased year by year until about 56,000 acres received water in 1925. About the same acreage is being farmed currently. The year-round growing season permits the raising of more than one crop on some of the lands. Often lettuce and cantaloupe crops are harvested from the same acreage in one year.

The crop production value on the project since water was first available in 1910 amounted to 145 million dollars, or 15 times the original cost of construction. In the early years from 1910 to 1914, crop returns ranged from $445,000 to $709,000. In recent years, they ranged from $8 million to a record of nearly $14 million in 1947. It is estimated that the value of livestock and livestock products sales from the project have amounted to a total of over $20 million during the last 37 years, or over twice the original cost of the system.

Reports show that 1,500 people were residing on farms on the project in 1912. The number increased to over 5,000 in 1920, but is now about 3,000. This decrease in farm population in recent years corresponds with an increase in the size of farm units resulting primarily from mechanization of farming. Especially in recent years, with the shift to vegetable production, a large number of agricultural workers are employed on a seasonal basis and not reported in the above figures. Also many agricultural workers live in town.

The number of people in the towns of Yuma, Somerton, and Gadsen, Ariz., and Winterhaven and Bard, Calif., increased from 3,150 in 1912, to about 30,000 at the present time. Nearly one-third of the urban population lives outside the city limits of incorporated towns, on subdivision tracts of land. In 1912, there were 2 people living in town for each person living on farms; now there are 10 people in town for each person residing on farms. Most of the people living in Yuma and other towns in the area obtain a living directly or indirectly from the agricultural development.

The trend in carload shipments of farm commodities from the project and shipments of all commodities to the project area are indicative of the growth in business activity for railroads, packing firms, and retail trade. Prior to 1917, less than 300 carloads of farm produce were shipped from the area. In 1946 and 1947, over 17,000 carloads of farm produce were shipped. Shipments of all commodities to the Yuma area increased from about 800 carloads annually in the early years to over 3,100 carloads at the present time.

Economists estimate that the farmer's dollar changes hands seven times before it comes to rest in the Federal treasury or is invested in capital goods. If this is true, nearly one-half of the business activity resulting from farm production may

accrue to the local towns, judging from a comparison of farm and business income in the Yuma area. Business gross income has averaged about $21 million annually during the period 1939–46 as compared with a value of crop production of 6.5 million dollars annually. Of course, not all of the business income originated from the farmers' dollars. On the other hand, the 21-million-dollar figure which is that reported for sales tax purposes, is not all-inclusive. Income for personal services, such as doctor and lawyer fees, transportation, and communication is not included.

The trend in post-office receipts, which in recent years were 300 to 600 percent of what they were in 1921, furnished another reliable measure of the growth in the Yuma area business activity. This was an increase of from $22,000 in 1921 to the high of $161,000 in 1943, and $91,000 in the latest year reported, 1946. Record receipt in 1943 to 1945 reflect wartime activity associated with operation of the Yuma Army Base and other military installations near Yuma which have not been a factor since 1945.

Expansion in the use of modern conveniences in Yuma indicates the establishment of business concerns and residences. Since 1929, telephones in service have increased 160 percent, gas connections 116 percent, water connections 107 percent, and electrical connections 62 percent.

Millions in Taxes Returned to Government

One concept of the national benefit of Reclamation projects is the extent to which the Federal Government obtains a return from the development in the form of Federal tax revenues. Federal taxes paid directly or indirectly from Yuma County are estimated to have totaled 37 million dollars for the 14-year period 1934 to 1947. This amounts to an average annual payment of $2,660,000.

A similar expansion in urban development to that of the Yuma area can be shown for most irrigation projects. Although it is not always readily apparent that the development has been dependent upon irrigation farming, at least local businessmen, often the most outspoken proponents of Reclamation, recognize the fact that they benefit from Reclamation development.

In view of these known benefits accruing from irrigation farming to nearby towns, and the dwindling number of projects which can be constructed and paid for by reclamation farmers, the question naturally arises, "Should not those who benefit from irrigation development share part of the costs?"

This is not a new idea. Urban beneficiaries have participated in repayment plans for a number of Reclamation projects. For example, the northern Colorado water conservancy district was organized to help repay the cost of the irrigation features of the Colorado-Big Thompson project, located in the State of Colorado. The district became the contracting agency with the Government, under legislation passed by the Colorado Legislature in 1937, and was authorized to levy an ad valorem tax on all real and personal property within the district boundaries. The rate of this tax on the property was not to exceed one-half mill during construction, nor one mill after construction is completed. Of the $600,000 annual payments for irrigation features expected at the time the contract was written, the district planned to raise $150,000 or 25 percent of the cost through a tax on both farm and nonfarm property. The remaining $450,000 to be paid annually would be collected from the water users.

The State of Nevada, by special legislation, authorized Washoe County to issue bonds in the amount of $500,000 which were to be used to pay one-half of the cost of Boca Dam and Reservoir, the reimbursable cost of which, in the amount of $1,000,000 was assumed by the Washoe County water conservation district. Under this arrangement, property not assessable by the district is taxed by Washoe County to repay the bond issue as an aid in paying the project cost.

The Carbon water conservancy district, having the same limits as Carbon County in the State of Utah, was formed for the purpose of contracting with the United States to repay the reimbursable costs of the Scofield project. All property within the conservancy district, including the principal towns of Helper and Price in Carbon County, is subject to ad valorem tax to the extent of one mill to repay the obligation which the district assumed in its contract with the United States. The cost of operating and maintaining the project is borne by the irrigators.

In New Mexico, the Middle Rio Grande conservancy district was organized to construct irrigation, flood control and drainage facilities. Under an assessment plan devised by the district, 43 percent of the construction costs are levied on agricultural property and 57 percent levied on nonagricultural property. Nonfarm participation is based largely on flood protection provided by levees. The district is comprised of lands below the main canals, and properties at higher elevations do not contribute to project costs.

Under the plan to rehabilitate the Middle Rio Grande area recommended by the Bureau, the conservancy district would become the contracting agent to repay project costs and the present division of costs between agricultural and nonagricultural property would be continued. This plan recognizes the fact that indirect benefits of irrigation, as well as flood protection, justify a contribution by urban property.

Other instances where town people have willingly participated in paying for reclamation could be cited, such as the Paonia project, Colorado; San Luis project, Colorado; Tucumcari project, New Mexico; and the Mancos project, Colorado.

THE END

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THE LAND

by BEN W. CREIM
Regional Power Manager, Region II, Sacramento, California

Shasta Dam and Power Plant.

BEFORE IT WAS OVER, the record-breaking spring drought of 1948 in the great interior valley of California had become a record-breaking early summer rainfall, and major disaster was averted. But during the despairing months of January, February, and March, every farmer in the Central Valley had learned a number of bitter, paradoxical lessons. It had been a strange kind of drought—strange and instructive. There was some water, but the power to move it was lacking.

In the valley's years-long race against the threat of drought, emphasis has naturally been placed on development of water itself, as the desirable end-product. While thousands of new wells have been sunk throughout the Sacramento and San Joaquin Valleys to tap the already dwindling underground water supplies, vigorous support has been given to rushing completion of the reservoirs and canals of the Central Valley project. Most of the farmers have taken little or no interest in the power development, despite the fact that here, as elsewhere, power is irrigation's "paying partner," and power revenues will repay a large share of irrigation's construction costs.

This year, however, the farmers realized with a start that a large preponderance of the Central Valley's irrigation supply is entirely dependent on electricity, and that they had been unwise to take power supply for granted.

Probably less than a third of the irrigated lands throughout the valley have a partial or complete gravity supply. All the rest use pumped water—either pumped directly from the underground, or pumped from streams into gravity canals. The pumps, in all but a few old-time installations, are powered by electricity. Suddenly, power was scarcer than water, and without power the water supply was useless. How this came about is a story fascinating in itself—the story of an upside-down year.

The growing period in the San Joaquin and Sacramento Valleys is divided into two seasons, the rainy season from November through March, and the season of irrigation from April into September, when little or no rain falls. The rainy season, of course, is all-important to the later irrigation season, carrying trees and vines through the budding period, preparing the soil for late-spring planting of irrigated crops and sufficing entirely for nonirrigated grains, pasture and a few tree crops. At this time the mountain reservoirs fill to provide simultaneous irrigation and power-production later in the summer, and the snow-pack is formed which will determine the amount of stream-flow diversion possible later on from snowmelt. Power use in the area is normally low during the rainy period, allowing the hydro-reservoirs to fill.

But the irrigation pumping load in the Central Valley is in itself a very large factor in the electrical economy and accounts for the area's annual peak, which usually occurs either in July or August. Clustered throughout the valley are no less than 40,000 individual wells tapping the underground water channels and nearly all powered by electric motors. The water level in most of the wells has been dropping steadily since 1930 because of overdraft, so the wells have had to be progressively deepened. Consequently, the amount of energy consumed in lifting water from even greater depths has increased rapidly. The wells vary in depth from 30 feet to over 2,500 and the motors to operate the pumps range in capacity from 10 to 1,500 horsepower. During the war, thousands of new pumps were installed, increasing the pumping load directly and, by further lowering the water levels, indirectly as well. The following table of agricultural power sold by the private company serving most of the area demonstrates the size and growth of the pumping load very graphically:

Year	Total kilowatt hours	Revenue	Average cost per kilowatt hour
1942	666, 662, 095	$8, 891, 421	$0. 0133
1943	706, 124, 875	9, 377, 155	. 0133
1944	842, 484, 789	10, 868, 013	. 0129
1945	889, 167, 857	11, 460, 550	. 0129
1946	1, 098, 843, 661	13, 100, 265	. 0119
1947	1, 376, 508, 304	15, 264, 700	. 01108

Even these figures, which show that power sold at agricultural rates has doubled in amount since 1942, do not completely indicate the scope of the pumping load. In addition, large irrigation districts and water companies, particularly along the Sacramento River, buy pumping power under other than agricultural schedules in order to pump surface water from the streams or to lift canal water to high lands. In the San Joaquin Valley, over 75 percent of all irrigation is from groundwater. Thus, except for the few fortunate areas where gravity diversion is possible, the entire irrigation supply of the Central Valley requires large amounts of electric

of the SKY-BLUE POWER

In the Central Valley of California, *Power is Water*— as Valley farmers learned this year, when the switches were pulled

energy, and in midsummer the area's electric facilities must meet their yearly peak demand—in contrast to the situation throughout most of the United States where, in midsummer, electric use is lower than in any other part of the year. When sufficient power capacity is available, this irrigation peak has a hand-in-glove efficiency, since the water which produces hydroelectric energy for the pumping load provides at the same time, farther downstream, the necessary flow for surface irrigation diversions.

In 1948, two things went wrong with this admirable arrangement:

- There was far less than enough power capacity to meet the normal situation; and
- The two seasons simply reversed themselves.

Here is how it happened.

During the war, every part of the area electric load had increased similarly to the pumping load, without any increase in installed power capacity. Steam plants, normally used only in dry years or for a few weeks during the year, had to be used more and more to meet normal load, on a 24-hour basis. By the peak summer season of 1947, the steam capacity was in constant full production and yet the area ran out of power. But the farmers were still not vitally concerned, because the only load which the company had to drop was its industrial contracts which could be interrupted, such as those with chemical plants. It was clear that trouble lay ahead during 1948. For just the natural growth of electric use in the area alone would exceed the small amount of new plants to be installed. Something more than the chemical plants would have to be dropped in 1948, while voltage and frequency were certain to fall below standard during the peaks. By January 1, demand had risen alarmingly and was riding close to the previous August peak. The electrical picture darkened day by day. Then the weather did its flip-up.

Rainfall had been about normal throughout October and November in most of the valley. December, however, was considerably less than normal. In most places, January began rainless and stayed that way. In the Sacramento Valley, it was the driest January since 1878, while on January 24 the San Joaquin Valley passed its previous record of 35 days without rain during the normally rainy season, a record set in 1912. On February 5, when less than half an inch fell, the drought broke at Friant Dam after 46 rainless days. But in all of February, the rainfall at Friant was less than 1 inch. It looked like the worst drought in history. Throughout California, prayers for rain were a prominent feature of every church service.

DIESEL AND GAS
POWER PLANTS
FOR FARM PUMPING
50 HP TO 400 HP UNITS
ARE IN STOCK
SAVE ELECTRICITY!
Here's How You Can Help
In The Power Emergency
If You Run a Business:
1. Turn off all window lights and electric signs.
2. Use no floodlighting—either exterior or interior.
3. Use electric power only when necessary.
If You Run a Factory:
1. Curtail power consumption wherever possible.
2. Shut off the "Peak"—Avoid use of electricity between the hours of 4 and 8 p. m., shifting operation to other hours wherever possible.
3. Check your plant and offices to eliminate all waste of electric power.
If You Are at Home:
1. Light no unused rooms.
2. Use appliances for as short periods as possible.
IMPORTANT EMERGENCY
NOTICE
Agricultural Power Customers
Agricultural power customers in the Stockton East Waterloo, Linden, Bellota Farmington Collegeville, French Camp, Lathrop, Manteca, Avena Atlanta River Junction, and Ripon areas are requested not to operate their pumping plants on TUESDAY of each week from the hours of 8 A M to 5 P M until further notice
Similar requests have been made of customers in other pumping areas in this Division Each area will be off the line one day each week
This curtailment of power use is necessary in order to ration the available supply
If you will follow this plan it will not be necessary to drop circuits each day
We invite and urge your compliance with this request
Thank you for your cooperation
Pacific Gas and Electric Company
P. G. & E.

Appeal to the public!

Irrigation had begun by the second week of January, mostly by orchardists and vineyardists who had to irrigate to save their trees and vines. Grain crops had been written off and stock was being shipped out, slaughtered or turned into the short-standing grain fields. A few specialty growers did some preirrigating, but most considered that any investment in planting was too great a gamble, since the outlook was that no vegetable crop would mature. By the beginning

of February, the irrigation pumping load was rising rapidly, just as normally it would rise between mid-April and the first of May. **The irrigation season was in full swing, in the middle of what should have been the rainy season.** It was then the farmers learned that power is water in the Central Valley.

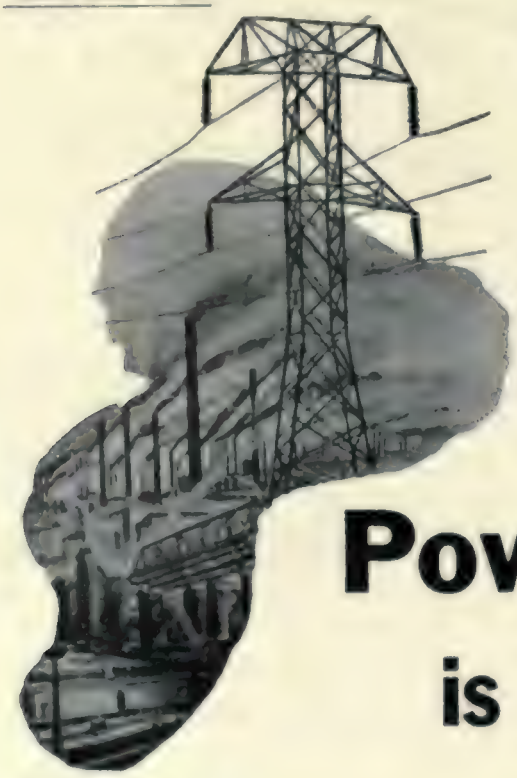
The partial pumping load, coming out of season and on top of the already tight power situation, precipitated an almost immediate crisis in power supply. The first signal was a drop in frequency, which caused electric clocks to slow down. Radio programs throughout northern California fumbled for a few days and in the cities everybody was late for work. The area was still experiencing winter conditions, which meant that the daily peak was occurring in the evening, so the power company appealed to the public to conserve electricity between the hours of 4 to 8 p. m. Business establishments were asked to black out display lighting, farmers were asked not to pump during peak hours and householders to cut down their use of electricity wherever possible.

Public response to this appeal was generally helpful, but the peak rose too rapidly in February for such voluntary restrictions to be very effective. On February 25 the State public utility commission stepped into the picture and imposed a 10 percent reduction on all uses of electricity, with a penalty of disconnection attached to violation. But the irrigation pumping continued to rise, and the utility companies began pulling switches on rural areas. This was more effective, since it struck at the central problem. The power was cut off for only an instant, but once deprived of power, the pumps had to be started by hand again. And, since they were at the other end of the farm, a moment's switch-off would serve to reduce the load for more than an hour—enough to get over the peak. Householders experienced only a momentary inconvenience, but the effect on irrigators was drastic. The only trouble with this technique was that it made the farmers hopping mad, and it did not get the fields and orchards irrigated.

The next step was a rotation-system for agricultural power shut-off—in short, to achieve on voluntary schedule what the switch-off method had effected involuntarily as emergency arose. Throughout the valley, announcements were printed in the newspapers, informing farmers on which day of the week they were not to operate their pumps between 8 a. m. and 5 p. m.

(*Continued on page 172*)

Shafter Press 8
FRIDAY, MARCH 12, 1948



Each Kilowatt of Electricity

WE CAN HELP SAVE

Means More Power For Agriculture

in the Shafter District

AND THROUGHOUT CENTRAL CALIFORNIA

Power Conservation

is YOUR JOB and MINE

Here Are Some Simple Rules:

1. Turn Out All Unnecessary Lights at All Times.

MERCHANTS OF THE TOWN OF SHAFTER IN CALIFORNIA'S CENTRAL VALLEY KNOW THAT THEIR LIVELIHOOD DEPENDS UPON THE WELFARE OF THEIR FARMER-CUSTOMERS. THIS SPRING THEY CAMPAIGNED FOR POWER CONSERVATION TO HELP SAVE THE CROPS BY MAKING MORE POWER AVAILABLE TO THE FARMERS.

Layout of this article by George V. Gideon

Deep Sea Diving in the West

Atop Belle Fourche Dam, Jim H. Thompson makes last-minute check-up on diving gear before his brother John starts another shift on valve repair work. ▶ Belle Fourche Reservoir appears in background.
Photo by T. R. Broderick, Region VI.

A mention of deep sea diving usually brings to mind an underwater scene wherein the hero, clad in the Man-From-Mars-like costume of a deep sea diver, fights with pirates, an octopus or other denizen of the deep, perhaps in a search for hidden treasure, and emerges exhausted but victorious—sometimes after having lost communication with those "on top" or cutting his life-line of oxygen.

Colorful, dramatic scenes like these have often been enacted inland. At present (See front cover, July 1948 issue) deep sea divers are searching for the clue to pirates of another sort—silt particles in Lake Mead which rob the West of life-giving water.

At Buffalo Bill and Belle Fourche dams in Region VI, deep sea divers were called in to help release the energy of a power plant, and free irrigation water blocked by a leaking valve.

The most hazardous of all diving jobs in Region VI was done in April of this year during four days on the Belle Fourche Reclamation project in northwestern South Dakota.

At the Belle Fourche project, water from Belle Fourche river is diverted by a 1½-mile-long diversion dam and carried 6½ miles through an inlet or supply canal to the Belle Fourche Dam on Owl Creek, a tributary of the Belle Fourche River.

Belle Fourche Dam, once one of the largest earthfill dams in the world, has a structural height of 112 feet and a crest length of 6,262 feet. Water is distributed from the reservoir to most of the project lands by means of the north and south canals.

Near the end of the 1947 irrigation season, the gatetender at Belle Fourche Dam discovered that the Ensign balanced valve, controlling the reservoir release into the north canal, had become unmanageable. The only way to regulate the flow of water through the valve was to run the control pump at high speed. This indicated there was a leak in the hydraulic system controlling the valve.

It became obvious that someone had to go down into the tunnel to see what was wrong. Accordingly, the valve was partially closed and an inspection was made. The cause of the trouble was discovered—a jet of water spurting from the face of the valve, indicating that the internal pressure necessary to control the valve was being lost at that point. Since it was not possible to keep the valve closed, the emergency gates were lowered. One of the gates was then used to control the reservoir release for the remainder of the irrigation season. The emergency gates, however, were not intended to regulate a flow which would meet the demands at the peak of the irrigation season. Therefore the valve which had failed had to be repaired, at least to the point where it would close—and stay closed. Water could then be regulated by its twin which is located beside it at the end of a fork in the tunnel. As these valves are to be replaced within the next 2 years the officials believed this stop-gap measure would take care of the situation temporarily.

As soon as the emergency gates were closed, the outlet tunnel and gate shaft filled with water to the level of the reservoir water surface. Obviously, only a deep sea diver would be able to repair the face of the valve. Invitations for bids for this work, issued by the Missouri-Oahe district office, resulted in the arrival of Capt. H. H. Thompson & Sons of Duluth, Minn.

The divers considered the type of operation necessary to be unusually hazardous. And, no wonder! The diver's only access to the leaking valve was by descending the gate shaft 70 feet to the floor of the tunnel and then walking about 200 feet up the tunnel to the valve. In an emergency, the diver would have to walk the 200 feet back to the shaft before he could possibly get out.

A hand winch was rigged to raise and lower a trapezelike platform to let the diver down the shaft until he was in the water and to bring him from the water to the top of the shaft on his ascent. While in the water the diver controlled his buoyancy through his air-relief valve. An air compressor, with a stand-by unit and ample receiver capacity, was lo-

GOING DOWN—Diver John F. Thompson is lowered into flooded gate shaft at crest of Belle Fourche Dam. Following a descent through 55 feet of water in the shaft, he will proceed 200 feet through the North Canal outlet to work on valve. *Photo by T. R. Broderick, Region VI.*

cated on top of the dam at the gate house to make sure the diver had an unfailing air supply.

The first time down, the diver made a thorough inspection of the face of the valve and discovered two holes—one at the top which had been observed before the emergency gates were closed, and another at the bottom of the face. The holes appeared to be the result of cavitation, or surface erosion of the metal as a result of the vacuum created by the rapid movement of water over the face of the valve. When the valve had been inspected before the 1947 irrigation season began, cavitation damage had not appeared to be serious.

By working with hand tools and a small air-powered grinder, the diver reamed the holes so that they could be patched. When reamed, the holes were a little more than an inch in diameter. The upper hole was patched by placing a metal plate, with a rubber gasket cemented to it, through the hole and drawing it against the inside surface of the valve face with a bolt through a plate on the outside. The lower hole was in a rather inaccessible place and the best remedy that could be devised was to ream the hole and drive in a turned wooden plug.

After the patches were in place, the hydraulic control pump

Left: View from top of Belle Fourche Dam, looking south (reservoir at right). Gate house with shaft which diver Thompson entered can be seen at left. Below: Diagram of OPERATIONS BELLE FOURCHE.

was put in operation to close the valve. But the valve had become jammed in the open position, and about twice the normal operating pressure was applied before it finally moved shut.

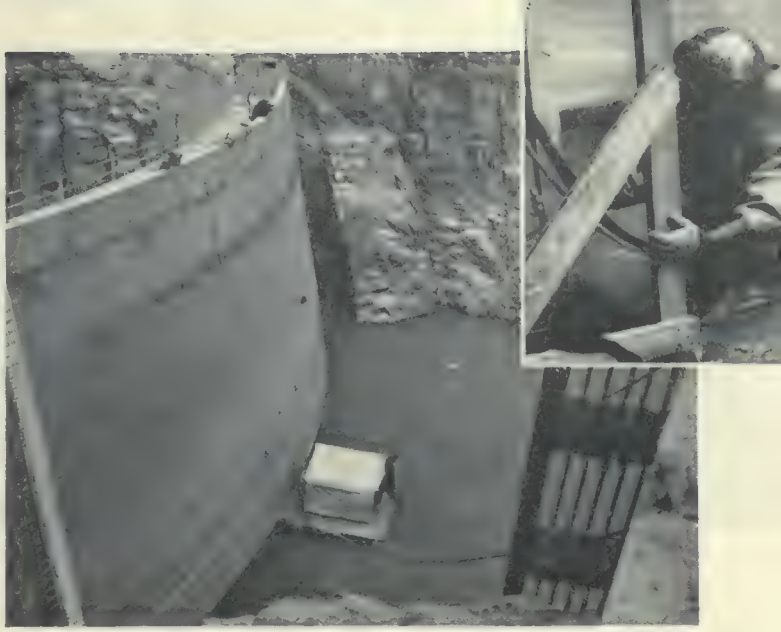
With the valve closed, the emergency gate was raised and the shaft and tunnel unwatered. Now the patching job could be inspected. There was a little leakage around the bolted patch, but caulking with lead wool put a quick stop to that. The inspectors reported the wooden plug was holding very well. The diver's work was accomplished in six diving operations performed in 4 days, with the diver working under water as long as 3 hours at a time. The temperature of the water was between freezing and 40° Fahrenheit. Fortunately, there were no mishaps and the work was accomplished without serious complications.

S. T. Larsen, Belle Fourche superintendent, stated, "While this is the first time it has been necessary to engage the services of a deep-sea diver on the Belle Fourche project, the work was accomplished in a very adequate manner and at less expense than was anticipated."

Back in March 1941, Shoshone project officials hired Walter McCray, a deep-sea diver from Seattle, Wash., to inspect trashracks at the inlet end of the pipes through Buffalo Bill Dam which lead to the power penstock. This was part of a routine inspection to remove any debris which may have been caught by the trashracks, which had last been cleaned out in the fall of 1932. Project officials installed a three-drum hoist so that they could use a one-half to three-fourths cubic-yard orange peel bucket for removing accumulated trash in front of the trashracks. McCray started diving on March 28, and reported his findings which were checked against the drawings of the trashracks and trashrack structure.

The conditions found by the diver checked with the drawings and the next day he went down to double-check. He found that both racks were obstructed with tumble weeds, sagebrush, driftwood and mud, piled higher than the tops of the pipes through the dam. He also discovered that the trashracks were not in proper position. This cleared up the mystery of why rocks and driftwood had been found in the power penstock pipes in 1940, but made it impossible to lift the trashracks until the debris had been removed. This took a greater part of a month, during which time McCray continued making inspections of the trashracks and reporting as well as possible the underwater conditions, telling the dredgers where debris was located so they could go to work with the bucket. He was unable to see anything below the surface of the water, which was about as clear as it ever gets, and had to depend entirely on touch and measurements when he made his inspections. However, the trash, consisting mostly of waterlogged sticks, tree stumps with roots attached, some rocks, silt and automobile parts, was cleaned out—several hundred cubic yards of it—and the racks removed, inspected and replaced.

Chester Womack of San Francisco, and his men, "Deepwater" Smith and Bill Swart arrived at Cody, Wyo., May 13, 1945, to investigate the condition of the trashracks at the Buffalo Bill Dam which had allowed debris to enter the penstocks since a rock slide the previous November. Several shutdowns had been required to remove this debris and it appeared that the penstock inlets were partially blocked.



Above: Diving operations conducted from a barge to clear inlets to power penstock caused by rock slide at Buffalo Bill Reservoir. Diver can be discerned by disturbance in water created by air escaping from his helmet. Note part of trashrack, at right, "on the way up" for inspection. Inset Diver "Deepwater" Smith leaving barge for 200-foot trip below water to continue probe. ***Above photo by Ed Witz, Region VI. Inset photo by C. T. Hinze, Region VI.***

Project officials had assumed that the trashracks had been damaged and that top grillage should be installed on the racks. Master Mechanic William J. Montgomery started dredging operations on December 4th, continuing for almost 3 weeks, until bad weather, complete with ice, set in. By that time the dredgers had dragged up 300 cubic yards of assorted trash, plus an automobile with 1937 license plates. [The mystery of the automobile has never been solved.—Ed.]

With the coming of spring, and the deep-sea divers, the water in the reservoir was lowered, and the original cause of the power shutdowns came into view—a place in the north cliff where a large quantity of rock had evidently "let loose" and which the power officials believed to be the origin of the slide which occurred on November 24.

This time the divers worked from an improvised barge, making two dives each day, with shifts "on the bottom" varying from several minutes to 23 minutes per dive. As in all diving operations under Bureau supervision, time spent working "on the bottom," decompression time and the number of dives per 8-hour-shift were governed by United States Navy Regulations. The job was another "feel and see" operation, as the divers' boots stirred up silt, making it impossible for them to see their hands before their helmets. In spite of these handicaps the divers located huge rocks (one averaging about 6 feet square and 18 inches thick) and other debris, and attached wire rope slings to them. The mechanics made their hauls via cableway between diving operations. Working from 161 to 196 feet below the surface, the divers continued their job of helping to clear the inlet, raise and replace trashracks, and make underwater inspections until the job was completed. The penstock was flushed out after the dredging and diving work had been finished and an inspection was made. A small quantity of debris was removed from the manifold trashracks and no more trouble was ex-

(Continued on page 177)

Taking a Poke at Poison Oak

Shasta Lake area may be freed of West's worst pest

by J. W. Koehler

Sacramento Valley District, Region II

Sacramento, California

The State of California, as any fair-minded geography student will freely admit, excels in every possible way. Everything is bigger and better in this more than normally excellent section of the country. Therefore the public school botany textbooks can afford to admit that: "Poison oak is the most widely distributed shrub in the State."

Poison oak is our Western counterpart of the East's poison ivy. Western poison oak found growing most often in the three West Coast States is not an oak but is a species of the same genus (*Rhus*) as is poison ivy. Another common species of this poisonous group is oakleaf poison ivy found mostly in the Southeast. Poison sumac, which is a true sumac, also belongs to this genus and is usually associated with bogs in the eastern part of the country.

The western poison oak is not to be dismissed lightly, as Webster does, with: "Any poison ivy of bushy habit." It resembles poison ivy the way an atom bomb resembles a firecracker. Its habits may sometimes be bushy; they are always beastly.

Robert Louis Stevenson in *The Silverado Squatters* recognizes the true character of this pest by stating: "In all our woods and by every wayside there prospers an abominable shrub or weed called poison oak, whose very neighborhood is venomous to some and whose actual touch is avoided by the most impervious." Stevenson well knew that having oak poisoning is like being seasick. You don't die of it. You just wish you were dead. And you can't avoid getting it like you can avoid seasickness or poison ivy. You do not *have* to take an ocean voyage. Of course, you *can* avoid poison ivy by staying out of the countryside, but California, with its 10,000,000 happy inhabitants, is still almost *all* countryside. People by the scores of thousands have to work in it. Every vacationer has to go through miles of it to get to the nearest luxurious, homelike vacation spot.

"The abominable shrub" first came under the Bureau of Reclamation's scrutiny when Shasta Dam was thrown across a canyon chocked with it. Countless thousands of man-hours were lost among construction workers who brushed against the plant, or handled tools which had come in contact with it. The problem continues in the area today, with the plant

Upper left: District Weed Specialist J. W. Koehler, spraying poison oak with a mixture of 2, 4–D and diesel oil in Shasta Lake area. Immediate left: Loading spray equipment on Bureau barge for poison oak elimination tests in Boy Scout Camp area, Shasta Lake, Calif. ***Photos by R. A. Midthum, Region II.***

At top of page, photo by A. E. McCloud, Region II, drawings by Shirley Briggs.

creeping right up to the back doors of the houses sheltering the fairly large permanent colony of Shasta Dam and power plant employees. And with the projected opening of a recreational area along Shasta Lake's hundreds of miles of shore line, some way of cheaply eliminating the weed became a large-scale necessity last year. Advice from State, county, and University of California weed specialists was sought. These experts all agreed that the new "wonder weed control chemical," 2,4-D, should be used for a large-scale trial application against the poison oak menace.

The first place chosen for the trial was the main council area of the new 600-acre camp of the Boy Scouts of America on Shasta Lake. Cooperating in this volunteer program with the Bureau of Reclamation specialists were the Boy Scouts, always ready to do a good turn, the National Park Service, The State of California Division of Forestry, The State Bureau of Rodent and Weed Control, the botany division of the University of California, the Shasta County Agricultural Department and the Shasta County Agricultural Extension Service; a total of 33 men and boys.

Sunday, May 4, 1947, was picked as POE (Poison Oak Elimination) Day.

At dawn a Bureau barge, laden with men and equipment, stole across the misty lake to a 10-acre beachhead on the steep foreshore.

The assault forces sprayed over 4 acres with a low-volume concentration of the butyl esters of 2,4–D mixed with diesel oil. The remainder got a dose of ammonium sulfamate, a more expensive but useful chemical which has been used for poison oak control for several years. Since the terrain was sloping and steep, only those areas accessible by road could be treated with the power-spray machines: a 65-gallon sprayer loaned by a chemical company for the 2,4–D, delivered at 20 pounds pressure; and Shasta County's sprayer sending forth ammonium sulfamate at 250 pounds. Inaccessible areas got ammonium sulfamate spot control from knapsack pumps strapped to the backs of the fighters. Weather conditions were favorable—maximum temperature 86° F. with a slight southeast breeze. Tired, unhappy and afire with blistering itch, the gallant band sloshed gallons of calamine lotion on each other as they retreated across the lake at sunset.

Walter S. Ball, Chief of the State Bureau of Rodent and Weed Control; W. A. Harvey of the University of California College of Agriculture; C. J. Graham, regional weed specialist, and the writer, returned to the scene of the battle just a year later. We found considerable light regrowth of about equal density in both the 2,4-D and ammonium sulfamate-treated areas. This regrowth was no worse than expected. Retreatment of the area should eliminate nearly all of the plants for good.

The most important results of the test was proof that at least under these particular conditions, 2,4-D, only a fifth as costly, is just as effective as ammonium sulfamate. (Cost of original 2,4-D spray and final respray amounted to $15 per acre as against approximately $70 for ammonium sulfamate.) The new chemical will have the additional benefit of being easier to handle—using lighter equipment than ammonium sulfamate takes—because low-volume spraying with it has proven successful. And of course, as already known, 2,4-D will not corrode the spray equipment.

Subsequently, trial applications of 2,4-D sprays were made on poison oak in and around the Bureau of Reclamation construction camp near Shasta Dam. These trials show partial control, with some regrowth, and spot-spraying should keep the camp area relatively free of the pest.

The Bureau's report indicated that the assault troops had established a successful counter offensive against the enemy which should result in holding casualties to a minimum. In the future it is hoped that fewer and fewer workers and vacationers will be harassed by "this skin irritant which often causes intense and extremely painful dermatitis." These cooperative tests give us hope of bringing under control at a price any Government unit, contractor or resort operator can stand, an ailment that doesn't kill or cripple for life, but can put a substantial portion of a working force out of commission or, like an outbreak of bubonic plague, drive tourists away from a desirable vacation area. THE END

The Land of the Sky-Blue Power

(Continued from page 166)

At about this time the Pacific Gas & Electric Co., which serves almost the entire area, was placing large ads in the local papers entitled "Facts About Power Curtailment," and informing, in a headline, that "Power Saved is Water Saved." A statement in the Shafter Press of March 12, paid for by 56 commercial firms in the town of Shafter, hit the nail on the head by beginning its full-page announcement with:

EACH KILOWATT OF ELECTRICITY WE CAN HELP SAVE MEANS MORE POWER FOR AGRICULTURE IN THE SHAFTER DISTRICT AND THROUGHOUT CENTRAL CALIFORNIA.

By the middle of March, the State commission had appointed an emergency power administrator, who promptly ordered a 20 percent curtailment in all electric use. This superseded the rotation plan and left farmers with the threat of having their electricity disconnected if they did not reduce their pumping by a full 20 percent.

At this point, desperate farmers began buying diesel-electric plants. Every Valley newspaper carried advertisements like one in the Oakdale Leader for April 1, which read:

Diesel and gas power plants for farm pumping are in stock—Reserved exclusively for ranchers. See us at once as the supply is limited.

The Farm, a San Francisco publication, reported on April 2 as follows:

Sale of diesel power plants is booming in the San Joaquin Valley. Big and little farm operators are scrambling for a source of energy that is not subject to restrictions, except those involved in price and availability.

Fresno dealers estimate "several hundred" diesel power plants have gone into service, or been ordered, in Fresno County and part or all of Madera, Kings, and Tulare, since the power shortage pinch. There are no exact figures but a fair guess would be nearer 1,000 than 500.

In April, the rains began, tentatively, then in volume, continuing through May—when normally the irrigation season would be getting into full swing. By May 1st, with 200,000 kilowatts of power being imported from southern California and the pumping load reduced by rainfall, all restrictions on power use were temporarily removed. Prospects were that Californians would get through the season without further mishaps.

To most northern California farmers, the true role of the Central Valley project as **a water project** had been considerably clarified, and they had learned a new respect for the power facilities at Shasta and Keswick Dams. During the critical months, however, Shasta Reservoir was storing for what threatened to be an historic dry cycle and the generators could not be operated at full capacity around the clock without seriously endangering the water storage. Nevertheless, in the 4 months from January through April, the project delivered better than 250 percent of its contract commitments (377 million kilowatt-hours instead of the 150 million required by contract) and at the same time achieved a full reservoir at Shasta. This achievement represented an all-but-perfect job in water management for a multipurpose reservoir. It was marred only by the fact that the totally unhoped-for mid-April rains made it necessary to release water for a few days to keep the reservoir from spilling uncontrolled over the flashboards that block the drum gate gap, and carrying away falsework for a bridge downstream. At the same time Shasta was storing precious water in anticipation of *future* drought, it was able to produce desperately needed electric energy to relieve the *present* water crisis brought about by power shortage.

The thousands of farmers in the Central Valley project service-area who do their own pumping were grateful for the CVP power this spring, when it was providing 10 percent of all the energy in northern California and saving them from much more drastic curtailment in their irrigation. In a land where power is water, the Central Valley project is throughout **a water project**—not in spite of its power features, but because of them. THE END

"Seepage Losses from Irrigation Channels" Now Available

The Colorado Agricultural Experiment Station, Colorado A&M College has announced the availability of Technical Bulletin 38 entitled "Seepage Losses from Irrigation Channels." The publication may be obtained by writing the Office of Information, Colorado A&M College, Fort Collins, Colo. The price is 50 cents per copy.

_____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

Sincerely,

Check (√) if member of water users association ☐

_____
(Name)

_____
(Address)

_____
(Name and address of association)

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(Include zone number, if any)

SUBSCRIPTION RATES

Twelve issues for $1.00 per year

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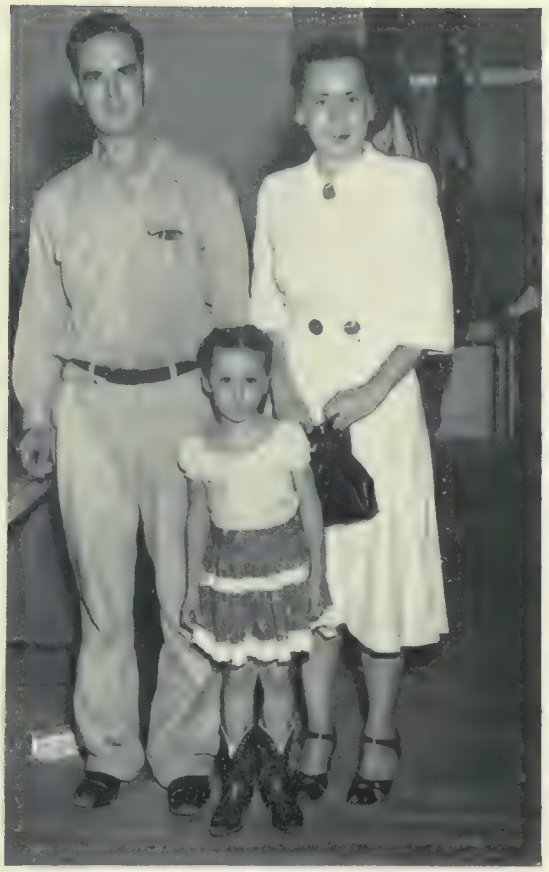
Gila Homesteaders Take Over

by IAN A. BRIGGS

Branch of Operation and Maintenance, Region III, Boulder City, Nevada



Yuma veteran Francis Henry Martin, his daughter, and Mrs. Martin were on hand to hear his name called on the 15th draw for one of the homesteads. ▶
Photo by Samuel B. Watkins, Region III.

On the sun-parched Yuma Mesa of the Gila project in southwestern Arizona 54 homesteaders are making irrigation history.

Colorado River water, sunshine, fertilizer, experience and hard work—these are the main ingredients that are going into some 5,000 acres of predeveloped public land now being settled by veterans from New Jersey to California and Oregon to Alabama. The newcomers to the mesa were selected by lot at a public drawing in Yuma, Ariz., last June 29. Most of them had not seen their homesteads until they went to Yuma after being notified their names were drawn.

"That alfalfa looks mighty good to me," homesteader William Ford Montgomery remarked in his best Alabama accent as he stood in the middle of one of the predeveloped plots on the mesa.

Homesteading on land with alfalfa kneehigh is something new in the settlement procedure. Unlike their forefathers who carved homesteads from raw land, the Yuma Mesa settlers are moving onto farms already under cultivation and producing crops.

But, one can hardly call the settlement program on the predeveloped farms of the Yuma Mesa an experiment. It is far more than that. It is an attempt of the Federal Government to make it possible for veterans, who otherwise would not have the opportunity, to have farms of their own.

During the war, the Bureau of Reclamation was authorized to level the mesa land, construct farm ditches, fertilize and seed the soil to a nurse crop and to alfalfa for the dual purpose of dust abatement and land preparation for settlement. This predevelopment has eliminated the gap between the entrance onto the land and the harvesting of the first crop. That gap has defeated homesteaders on other projects who did not have the financial resources to "last." It is a long hard struggle for the settler who must level his own land, construct his own farm ditches, plant his crops and wait for the harvest, particularly on the Yuma Mesa where land preparation is extremely exacting, and correspondingly expensive. All this has been saved the Yuma Mesa settler whose alfalfa crop provides cash and a good start in his battle to conquer a desert soil which for many centuries had lain dormant.

Despite the apparent advantages of the predeveloped farms, the picture on the Yuma Mesa is not as rosy as some may imagine. Farming on the southwest desert is never a "cinch" even under the most favorable of circumstances. This fact was expressed aptly by Regional Director E. A. Moritz of the Bureau of Reclamation in his speech at the drawing for the Gila homesteads.

"Some years ago there was a sign in a midwestern railroad depot advertising land in Mexico," Moritz recalled. "The advertisement bore the legend 'the hand that shuns the thorn will not pluck the rose.' This legend may well be applied to the mesa homesteaders even though the desert thorns have been replaced by lush alfalfa. Their homes must be built on firm foundations of ability, the will to work, and the real determination to succeed in a new land. The mesa settlers will not have easy going. They must have patience. They must learn new ways in the science and art of agriculture. There will be compensations for those who possess those attributes. We sincerely believe that the mesa farms offer success to those who go after it."

Here are a few of the facts concerning the mesa homesteads: The porous sandy mesa soils have no humus and require large quantities of irrigation water. Fortunately, water costs, although high, are not as high as many irrigation farmers now pay. Deficient in phosphorous and other nutrients, the soils require large quantities of fertilizer. The kinds of crops that can be grown are limited. Special methods of farming are required for the mesa soils and even those homesteaders who are experienced irrigation farmers may have to forget their old ways and learn again.

The homesteader will be required to repay the predevelopment and construction costs on his land over a period of 70 years. Therefore, probably not in his lifetime will he own his land free of incumbrance. The predevelopment costs repayable by the homesteader, are estimated to amount to

$150 and the construction charges will average about $200 an acre—ranging from $260 per acre on class 2 land, which is the best on the division, to a minimum of $120 on class 3 land. The settler is not required to begin paying the construction charges until 10 years after entry onto his land. These payments will extend over a 60-year period. However, he must begin repaying predevelopment costs immediately. These payments as currently proposed will extend over a 30-year period with the annual payments of $8 an acre for the first 10 years and $2.50 per acre during the following 20 years. In addition to the predevelopment and construction charges, the settler must pay operation and maintenance charges which will average $7.70 per acre for delivery of 10 acre-feet of water, under the current public notice. Hence, the total annual cost during the first 10 years, which is considered the development period, is expected to approximate $15.70 per acre.

Although costs are high—averaging $350 an acre—the homesteader has the advantage of using interest-free money which was advanced by the Government to predevelop the farms and construct an irrigation system. What the homesteader pays for construction and predevelopment on class 2 land on the mesa without interest is about the same as he would invest in private land of equal productivity at $139 an acre, assuming 5 percent interest on his loan.

To date, alfalfa is the leading crop on the mesa. Some of the Southwest's finest grapefruit is grown on several hundred acres of privately owned land on the lower end of the mesa, in what is known as the Yuma Auxiliary project. Potatoes, tomatoes, and peas, planted on small acreages on the mesa have shown some promise of becoming profitable crops. Commercial plantings of table grapes indicate that promising results may be anticipated with that crop.

Work with many crops is still in the experimental stage. The Bureau of Reclamation, the Bureau of Plant Industry, and the University of Arizona are engaged in a three-way cooperative project on the mesa to explore new crops, fertilizer treatment, methods of irrigation and other factors. These agencies will continue to work with the mesa settlers and advise them in establishing sound farming practices with recommendations correlated by the county agricultural agent. And the settlers, to be sure, will have many worth-while ideas of their own. The land is theirs to do with as they wish. They are free to plant any crop or crops of their choice without dictation from any agency or organization.

The best land on the mesa has yielded as high as 8 tons of alfalfa hay to the acre. Five tons per acre is considered a good yield for the mesa soils. With alfalfa selling this year at around $28 a ton the outlook for that crop is most encouraging to the mesa homesteader.

The Yuma Mesa receives a dependable water supply from the Colorado River for a 12-month growing season. Construction of the Gila Canal headworks at Imperial Dam, 18 miles northeast of Yuma, began in December 1935. Three pumps lift the water 52 feet from the main canal onto the mesa where it flows through a distribution system to the fields.

Work on the mesa development was virtually halted during the war. However, under special authorization, the Bureau of Reclamation was permitted to develop several hundred acres adjacent to the Yuma Army Air Field and plant it to alfalfa as a dust control measure. Work was resumed on a full scale immediately after VJ-day. The land now being settled includes 4,940 acres divided into 54 farms ranging in size from 40 to 160 acres, the smaller farms being most suitable for production of specialty crops such as citrus. Each of the homesteaders was privileged to indicate his selection of the type and size of farm he desired.

The land was opened to homestead entry last December 30 and during the following 3-month period veterans of World Wars I and II, the Spanish-American War and the Philippine Insurrection had preference in filing. Nine hundred and twelve applications were received and of this total 609 were approved by the settlement board for the drawing. Subject to final approval by the examining board, California had 21 successful homestead applicants, Arizona, 8; Oregon, 4; Texas and Colorado, 3 each; Iowa, New Mexico, Oklahoma, and Illinois, 2 each; Alabama, Kansas, New Jersey, Wyoming, Utah, Missouri, and Ohio, 1 each.

Since most of the applicants were out-of-State, few were present for the drawing and only four of these heard their names called for one of the 54 farms. They were: Francis H. Martin, Dan E. O'Connell, and John R. Scarbrough, Jr., all of Yuma, and Baldwin W. Foote, of San Diego, Calif.

Martin, a salesman with an implement firm in Yuma, came to Yuma 2 years ago from California. He formerly was a wheat farmer at Banning and Tulare, Calif. During the first World War he served with the Ninth Trench Mortar Battalion.

The Yuma Mesa homestead will give him a chance he has always wanted—a chance to be in business for himself. "I'm tired of working for the other fellow," he declared. "I want to build something for myself." He thinks he may try his hand at growing winter vegetables on his mesa soil. Martin is 49, is married and has a 5-year-old daughter.

Winning one of the homesteads has helped Foote to realize a lifelond ambition to become a farmer. During the first World War he was a captain with the 4th Division, in France and Germany. In the second World War he was stationed in the Hawaiian Islands as a lieutenant colonel. He is married and has a 4-year-old daughter.

O'Connell hails from Nampa, Idaho, and plans to leave his land in alfalfa for a while and go into livestock raising. During the first World War he was with the Three Hundred and Forty-fifth Field Artillery in Germany.

Twenty-six-year-old Scarbrough wears the Purple Heart for his service with the Two Hundred and Ninth Combat Engineers in northern Burma during World War II. Prior to winning the mesa homestead he was a custom farmer and did land leveling jobs in the Yuma area. He plans to leave his land in alfalfa until he can determine the most suitable crops. The experimental crop of grapes being grown on the mesa especially interest him. Scarbrough, a native Oklahoman, went to Yuma soon after his discharge from the army early in 1946. He is married and has a 17-month-old daughter.

Martin, Foote, O'Connell, and Scarbrough, are representative of the high caliber of men who are homesteading on the Yuma Mesa—men who are being rewarded with a fraction of the soil they fought to protect. THE END

Drainage and Irrigation in the Willamette Valley

by LEE McALLISTER

Planning Engineer, Region I, Salem, Oregon

This giant rhubarb grown on Neal Thompson's place near Canby, Oregon, is only one of the many irrigation products of the Willamette Valley. *Photo by F. B. Pomeroy, Region I.*

Regions with contrasts more intriguing than those of the Willamette Valley in northwest Oregon are uncommon. Such a combination of humid winters and arid summers is unparalleled farther east. This rich agricultural valley produces an amazing variety of specialty crops, while being dependent primarily upon diversified farming. Although it is one of the oldest Anglo-Saxon farming communities west of the Mississippi, it is still an area of young expanding economy. It is so young, in fact, that virgin natural resources are still being developed, and population is increasing rapidly under the impetus of war-established industries. Perhaps the outstanding contrast in agriculture, however, is the existing need for both drainage and irrigation.

To the pioneer settler, the Willamette Valley must have seemed a Garden of Eden after the desolate wastes crossed by the old Old Oregon Trail. Here he found in abundance wood, water, and fertile land, the three essentials of successful pioneering. These three are still the basic natural resources, conservation of which will assure a firm foundation for a continuing high standard of living. The valley when first settled was covered with fir forests interspersed with open treeless prairies. Lands adjacent to the rivers were settled first. Earliest farming was of the subsistence type, though for a short period cattle ranching was important. However, the settlers soon turned to grain production, and for a long period the principal export was wheat transported out over the navigable rivers. Gradually, as markets and transportation facilities expanded, farming became more diversified until the present wide variety of products was reached.

The importance of general farming in the Willamette Valley is often obscured by the spectacular nature of its many specialty crops. The 1940 census shows that in the nine valley counties $22,500,000 worth of field crops, dairy products, and livestock were sold or traded in 1939. The value of fruit, truck, and miscellaneous crops sold or traded was $10,000,000. More than 65 percent of the total crop land produced forage, grain, and seed. A deficiency in forage is met by importation of hay and increasing pasture yield by irrigation.

In the production of specialty crops, irrigation is of further importance. Small fruits, canning vegetables, some seeds, bulbs, and peppermint are all irrigated to some extent. The entire acreage of some canning vegetables is irrigated. The wide range of high value crops results largely from the favorable climate.

Climate in the Willamette Valley is mild. Destructive winds, hail, and thunderstorms are rare. Freezing periods are infrequent, and summer temperatures are, in general, moderate. The frost-free period varies but averages about 200 days, though hardy crops grow much longer. Often the shorter season east of the Cascades has more effective heat and matures crops earlier.

The floor of the basin, partially in the rain shadow of the coastal upland, has the least precipitation, averaging 38 inches per year. However, rainfall is inadequate for shallow rooted, late maturing crops, as only 15 percent of the annual precipitation falls in the five summer months. In June, July, and August, the rainfall averages only about 2 inches and is often less than 1, or about equal to that in the semiarid districts east of the Cascades. It is generally conceded that at least ½ inch of rain in 20 consecutive days is required for dry-land crops.

While the periods of deficient rainfall are prolonged and severe, excessive precipitation in winter is also a problem. December is the wettest month when more than 10 inches of rainfall in 3 days has been recorded at Portland. Stream

Snap beans thrive on sprinkler irrigation system in the Willamette Valley

Higher Valley lands are adaptable to the lower cost of gravity irrigation.

flow follows the same cycle as precipitation. The need for flood storage is evident as is also the necessity of summer storage releases if any but a minor portion of the Basin's water resource is to be utilized.

Mention of the green Willamette Valley is commonplace. For three seasons of the year it is green indeed, but in late summer large portions support no growth following the harvest of early maturing crops. Such widespread fallow areas, when temperature conditions and soil fertility would allow continuing production, does not indicate full use of land and water resources. Crops which are established over a high water table are left with only a shallow feeding zone when ground water recedes in late summer. Drainage and irrigation are thus parallel needs. Neither in itself is a complete solution to the problem, for both are needed to maintain a proper soil-moisture balance.

Farmers in the Willamette Valley recognized limitations of the climate at an early date. Selection of crops adapted to the climate was such an effective solution for this limitation that the supplementary solutions of drainage and irrigation are not always evident. Some crops, for example, hops and fiber flax, owe their remarkable success to the assured dry harvest season. The continuing expansion of irrigated and drained areas however, demonstrates the recognized value of water conservation.

Five drainage enterprises serving 16,000 acres were reported in the valley in 1940. There are many other cooperative and private ditches serving small areas. The need for drainage on a small scale has been satisfied fairly adequately. There are larger areas having more difficult financing problems which still need drainage construction.

The 1940 census reports 27,205 acres irrigated in the valley in 1939. Informed sources estimate present irrigated acreages at twice to three times this amount. A pumping plant, serving a portion of one farm through a sprinkler system, is typical irrigation development. Irrigation of this type is confined largely to the river bottoms where water is readily available, the surface is too rough for gravity distribution, and the soil is adapted to high value crops. On the higher valley lands away from the streams, the land is smoother and adaptable to the lower cost gravity irrigation, but most wells have a low yield. These higher lands therefore are more suited to development by project.

Four non-Federal irrigation projects now operate in the Willamette Valley. Two of them, the McKenzie and Muddy Creeks projects, irrigate main valley lands rather than river bottoms. Both are non-profit cooperative organizations with a simple diversion plan. They demonstrate the possibility of large scale irrigation, but are not typical of potential future development because of their low costs and simple financing. Additional projects may be more difficult to develop where diversion and distribution are more complex and reservoirs are needed for sustaining summer flows.

The Corps of Engineers began investigation of the Willamette River after approval of the River and Harbor Act of 1927. During the next 10 years examinations and surveys following various directives from Congress, chiefly with regard to flood control and navigational features, culminated in a project report submitted March 12, 1938. On June 28, 1938, Congress authorized the Willamette Valley project. The present project plan includes 13 primary flood control reservoirs. Two of these reservoirs are completed, and operating and construction has begun on two others. Reservoir space for flood control in the 13 reservoirs is to be filled gradually in early spring after destructive floods are no longer expected. This plan would provide 566,000 acre-feet of water per year for irrigation.

The Bureau of Reclamation began irrigation studies of the Willamette Basin in 1940. It was immediately apparent that any extensive irrigation must depend upon reservoir storage because of over-appropriation of summer flows and limited extent of ground-water supplies. In these first studies, releases from only the primary flood-control reservoirs were contemplated for irrigation. Later studies were extended to other fertile tributary valleys not included in the primary flood-control plan. In all, the 21 potential irrigation projects summarized in the table on page 177 have been selected for investigation. The annual irrigated acreage under all these projects would be 414,700 acres, which is 80 percent of the irrigable area.

The Bureau of Reclamation has completed land classification surveys of the Cottage Grove, East Long Tom, West Long Tom, Salem, Yamhill, Canby, and Tualatin projects. Considerable other project studies have been made, including preliminary surveys, preparation of preliminary plans and estimates, cooperation with the Corps of Engineers on plans for storage and flood control, and aerial mapping. Dam and reservoir surveys including core drilling have been completed for the Yamhill and Tualatin projects, and diversion dam and pumping site surveys have been completed for the West Long Tom, Canby, and Cottage Grove projects. Surveys of the main canals and inspections of the drainage requirements were made for all seven projects except West Long Tom. Field draft reports on many phases of the seven projects have been completed. Field work has not begun on the other 14 potential projects. Complete reports on the Canby and East Long Tom projects are scheduled for release to cooperating agencies in the near future. THE END

POTENTIAL IRRIGATION PROJECTS—WILLAMETTE BASIN, OREGON

PROJECTS UNDER PRIMARY FLOOD CONTROL RESERVOIRS

No.	Project	Acres [1]	Source of supply
1	Cottage Grove	5, 300	Row R. and Coast Fork.
2	Pleasant Hill	1, 000	Middle Fork.
3	Eugene	8, 600	Willamette River.
4	Springfield	7, 000	McKenzie River.
5	Coburg	28, 000	Do.
6	East Long Tom	8, 400	Long Tom River.
7	West Long Tom	5, 000	Do.
8	Albany	20, 000	South Santiam River.
9	Scio	15, 600	Do.
10	Stayton	11, 200	North Santiam River.
11	Salem	74, 400	Do.
12	Willamette Flood Plain	76, 800	Willamette River.
	Subtotal	261, 300	

PROJECTS UNDER AUXILIARY RESERVOIRS

13	Brownsville	3, 400	Calapooya River.
14	Calapooya	12, 300	Do.
15	Independence	8, 300	Luckiamute River.
16	Yamhill (3 units):		
	Amity and McMinnville	43, 400	South Yamhill River.
	Carlton	9, 200	North Yamhill River.
17	Molalla	32, 500	Molalla River.
18	Canby	1, 700	Do.
19	Clackamas	2, 200	Clackamas River.
20	Tualatin (3 units):		
	West and South	21, 000	Gales Creek.
	East	15, 900	East Dairy Creek.
21	Marys River	3, 500	Marys River.
	Subtotal	153, 400	
	Total	414, 700	

[1] 80 percent of irrigable area.

Deep Sea Diving in the West

(Continued from page 169)

perienced. According to the project officials, "The divers were very conscientious and they made a special effort to do a thorough job. They cooperated with Bureau employees at all times and assisted with work that was not directly connected with diving operations." THE END

The foregoing article was based on material submitted by Region VI officials, including a sketch by S. T. Larsen, superintendent of Belle Fourche project, from which the drawing appearing on page 168 was prepared.

Medicine Creek Dam Dedication

Artist M. H. Wilson's conception of Medicine Creek Dam.

On August 10 approximately 15,000 persons attended a celebration at Cambridge, Nebr., for Medicine Creek Dam, second large structure to be dedicated in the Republican River basin-wide program.

Mr. H. L. Mousel was chairman of the Cambridge Citizens Committee in charge of celebration. Among the distinguished speakers present for the occasion were Senators Hugh Butler and Kenneth S. Wherry of Nebraska, Hon. Carl T. Curtis, Nebraska, Governor Val Peterson of Nebraska, General Lewis A. Pick, Corps of Engineers, Department of the Army, Harry D. Strunk, President of the Republican Valley Conservation Association, and Assistant Commissioner Kenneth Markwell, Director of Operation and Maintenance Lineweaver, and Floyd E. Dominy representing the Bureau of Reclamation and the Department of the Interior.

A large early morning parade preceded the dedication at the damsite which was followed by a huge free barbecue donated by the Cambridge citizens in the afternoon. The festivities were concluded with a community banquet and street dance in the evening.

NEXT MONTH—How scientists are salvaging the keys to North America's history buried at the Medicine Creek site. Read "Saving a Segment of History" by Dr. Jesse D. Jennings, Archeologist, Region Two, National Park Service.

A Build-Up From "Down Under"

The Americans have published some very fine books and papers, and one in particular, Control of Weeds on Irrigation Systems, by the Reclamation Bureau of Department of Interior, deals with the subject very fully.

(Extracted from March 1948 issue of SPILLWAY, OFFICIAL SUPPLEMENT TO STAFF MAGAZINE, State Rivers and Water Supply Commission, Victoria, Australia.)

Reclamation's 1948-1949 Construction Program

At the annual programing conference held in July at Grand Lake, Colorado, Reclamation administrators and engineers from the 17 Western States drew up a plan for orderly construction on reclamation projects during the 1949 fiscal year.

The all-time record appropriation of $250,000,000 will provide for bringing reclamation water to over 125,000 more acres and making available over 260,000 additional kilowatts of hydroelectric generating capacity during the coming year.

A break-down of the work by regions as now planned follows:

REGION I (Headquarters, Boise, Idaho)

Idaho

PALISADES. $1,725,000; Continuation preconstruction work and pending consummation of water savings agreements, required by law, if agreements are made by March 1, 1949, provision is made for the start of construction of the storage dam.

RATHDRUM PRAIRIE (Hayden Lake Unit): $107,000; Completion of overhaul pumping facilities; replacement 8,600 feet steel and concrete discharge pipe lines.

ANDERSON RANCH DAM (Boise Project): $5,600,000; Complete dam, continue construction of spillway outlet works, powerhouse; manufacture of turbines, generators and equipment.

PAYETTE DIVISION (Boise Project): $1,500,000; Complete construction of Cascade Dam outlet works, main canal system, railroad relocation; clearing reservoir; construction on highway construction, water pipe line for town of Cascade and on pumping plant; completion by 1950.

LEWISTON ORCHARDS: $1,215,000; Complete construction Sweetwater siphon; work on irrigation pipe lines, Clearwater reservoir and domestic water distribution system.

MINIDOKA: $131,000; Complete canal and lateral systems of Gooding Division; continue project development activities; investigations of feasibility of supplying irrigation water to proposed Northside pumping division.

Montana

HUNGRY HORSE DAM (near Kalispell): $14,600,000; Construction work on major concrete dam; start work on powerplant and on manufacture of turbines, generators and equipment. Completion expected by 1954.

BITTER ROOT (Rehabilitation): $40,000; Repair of gates at Lake Como Dam; reconstruction of existing wooden irrigation flume.

Oregon

OWYHEE: $191,000; Complete construction of canal, lateral systems, and other features of the project.

DESCHUTES: $978,000; Complete construction of main canal and Willow Creek siphon; construction of Wickiup Dam, reservoir and lateral system; to be essentially completed.

OCHOCO DAM (near Prineville): $350,000; Surveys, studies and rehabilitation work. Completion by 1950.

Washington

YAKIMA (Roza Division): $1,837,000; Complete eighteen small pumping plants, pump, laterals, transmission lines to supply pumping power; continuation construction of shops, warehouses, and operators living quarters.

YAKIMA (Rehabilitation): $100,000; Construction of pipe line, Prosser Irrigation District; repairs to spillway channel at Keechelus Reservoir; repair outlet channel Kachees Reservoir; repair outlet gate, spillway Bumping Reservoir.

COLUMBIA BASIN: $45,000,000; Continue presently contracted construction work; award contract for construction of primary pumping plant at Grand Coulee Dam to house 12 of the worlds' largest motors and pumps; start work on Soap Lake siphon and additional portions of primary canals to advance availability of irrigation water to project lands by 1952; continue electrical installations to enable early completion of another block of badly needed power.

REGION II (Headquarters, Sacramento, Calif.)

California

CENTRAL VALLEY: $43,000,000; Installing drum gates of Shasta Dam to increase storage capacity; complete installation of last two 75,000 kw generators at Shasta; temporary connecting transmission lines to Shasta Substation; continue work on East Side transmission line from Shasta Dam to Tracy Pumping Plant, including switchyards at each end; continue work on Delta Mendota and Friant Kern canals and Tracy Pumping Plant pointing to beginning water deliveries in 1951; completion Contra Costa canal; starting work on irrigation distribution systems for two and possibly a third irrigation district.

SANTA BARBARA: $1,000,000; Start work on Tecolote Tunnel and Goleta Conduit.

ORLAND (Rehabilitation): $50,000; Start repairing head gates at Stony Gorge and repairing flumes.

REGION II (*continued*)

Oregon-California

KLAMATH: $2,200,000; Continue work on diversion channel between Lost River and the Klamath River and channel work in Poe and Langell Valleys; work to provide increased flood protection for leased lands and new veterans' homesteads.

REGION III (Headquarters, Boulder City, Nev.)

Arizona

GILA: $2,640,000; includes $2,000,000 to start work on Wellton-Mohawk division, embracing construction of canal and three pumping plants; installation of supplemental sprinkler irrigation system.

SALT RIVER (Rehabilitation): $275,000; start replacement of worn-out irrigation structures; reshaping and lining certain parts of canal system.

YUMA (Rehabilitation): $264,000; (including $14,000 advanced by water users). Start replacement of worn-out irrigation structures; rebuilding and lining certain parts of canal system; continuation of investigations.

Arizona-California

PARKER DAM POWER: $480,000; construction housing, streets and utilities for new machine shop building; general improvements for new equipment to powerhouse and switchyards.

Arizona-Nevada

BOULDER CANYON: $2,790,000; start manufacture two additional generating units to be installed at Hoover Dam to produce power for the State of Arizona; additions and improvements to the Boulder City water and electric systems; construction additional housing facilities; start construction of high school building in Boulder City; miscellaneous improvements to powerhouse and dam and reservoir area.

DAVIS DAM: $23,325,000; continue construction of the dam, reservoir and power plant; construction tunnel facilities at switchyard; continuation construction Davis Dam backbone transmission grid; completion second 115-kv line Phoenix-Tucson.

Arizona-Nevada-California

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM: $1,170,000; complete purchase of river dredge; dredging operations in the Needles, California, area; river control investigations, channel and levee maintenance and drainage for protective works.

California

ALL AMERICAN CANAL: $7,726,000; start construction of lateral distribution system on Coachella Division; complete work on flood dikes and wasteway; continue minor work on Coachella Canal.

REGION IV (Headquarters, Salt Lake City, Utah)

Colorado

GRAND VALLEY: $4,600; Surveys of Garfield pumping division.

MANCOS: $1,021,000; Contemplates completion work now under way including Jackson Gulch Dam and inlet and outlet canals.

PAONIA: $1,005,000; Start construction on Spring Creek Dam and Fire Mountain Canal Enlargement.

Idaho

PRESTON BENCH: $425,000; Contemplates completion of work 15.6 miles of new canal and a 1,280 ft. tunnel to replace present Munk Creek Canal.

Nevada

HUMBOLT (Rehabilitation): $110,000; Start rehabilitation and improvement of existing project.

Utah

HYRUM (Rehabilitation): $48,000; Start rehabilitation and improvement of existing project.

NEWTON: $127,000; Completion of dam and reservoir.

OGDEN RIVER: $117,000; Continuation of canal and distribution system.

PROVO RIVER: $2,719,000; Continuing work on last 7.8 mile section Salt Lake Aqueduct in Salt Lake County; Jordan Narrows Siphon and Pumping Plant; start work on remaining excavation for Duchesne

(*Continued on page 180*)

News Round-Up

Upper Basin States Reach Agreement On Division of Colorado River Water

Representing the United States at Vernal, Utah, Chairman Harry W. Bashore, of the Upper Colorado River Basin Compact Commission, has reported that agreement has been reached by the Upper Basin States (Colorado, New Mexico, Utah, Wyoming, and Arizona) with regard to the apportionment of the use of water allotted to them by the Colorado River Compact.

This agreement comes more than 25 years after the seven-State Colorado River Compact headed by Chairman Herbert Hoover was initialed in 1922 at Santa Fe, N. Mex. The purpose of the compact was to agree upon a division of the waters between the Upper and Lower Basin States.

The tentative Upper Basin States Agreement is a forward step in the development of the Colorado River which is the primary resource of the region. If completed in detail, executed, and approved by the legislatures of the respective States and by the Congress, it will clear the way for the Secretary of the Interior, through the Bureau of Reclamaiton, to proceed to the actual development of main stream reservoirs of the upper basin, thus providing power and irrigation water and storage to assure fulfillment of the Upper Basin's obligations under the Colorado River Compact and the Mexican Treaty, notwithstanding future developments in the Upper Basin.

Bashore reported that the agreement for allocating Colorado River water was based on the following apportionment of water among the Upper Basin States:

50,000 acre feet allocated to Arizona and balance percentagewise * * * 51.75 percent to Colorado, 11.25 percent to New Mexico, 23 percent to Utah, and 14 percent to Wyoming.

The tentative agreement has been reduced to writing and it is hoped it will be completed and executed by the Commissioners at a meeting in October at Bishop's Lodge, Santa Fe, site of the original Colorado Compact.

Reclamation Activities in Alaska

The Bureau of Reclamation has established an investigations office at Juneau, Alaska, headed by electrical engineer Joseph M. Morgan who will explore the water power possibilities of the Territory with a view to future expansion of settlement and industrial development.

These studies were made possible by an appropriation of $150,000 granted to the Bureau for the work during the fiscal year 1949. Reclamation's survey of the water resources will round out a program already under way by other Interior agencies on mineral, geologic, fisheries, wildlife, and other resources designed to enrich the multiple-purpose development in Alaska.

The existing shortage of electric power makes these investigations necessary for industrial expansion and settlement. One of the most pressing problems to be considered will be development of a power supply at Eklutna Lake to provide adequate resources for the city of Anchorage, for the electric cooperatives in Matanauska Valley, for the Alaskan Railway, and for Indian Service installations.

Other studies will include Juneau, Sitka, and Ketchikan. Development of a suitable power supply at Ketchikan would be designed to assist materially in creation of a pulp industry to alleviate newsprint shortages faced by the American public today.

Engineer Morgan will be assisted by Richmond C. Johnson, formerly area engineer for the Bureau at Salt Lake City. The staff consists of a hydrologist, geologist, field engineers, and a draftsman. This is the first work that the Bureau of Reclamation has done in Alaska.

Hells Canyon Project Report Under Study

The Hells Canyon project report for the Columbia River Basin was submitted to the Basin States for review and comment after its approval by Secretary of the Interior J. A. Krug.

The report provides for the construction of a concrete dam in the Snake River Canyon between Weiser and Lewiston, Idaho, which would tower approximately 740 feet from bedrock to the top. This would be one of the key features of the Columbia River Basin Plan and, combined with other reservoirs, could help control the flood waters which recently poured into the Columbia River with catastrophic results.

Cooperative Combine to Work in Missouri Basin

Representatives of the Extension Services and Experiment Stations of universities and agricultural colleges of the Missouri Basin States met at Lincoln, Nebr., July 16 and 17 to discuss ways and means for integrating their respective programs with the Missouri Basin Project development of the Bureau of Reclamation and the Corps of Engineers. This was one of the first concerted moves on the part of the State colleges to participate directly in the development phases of the Missouri Basin program and was welcomed by the Bureau of Reclamation which has been perfecting details with the State institutions as the focal point for cooperation with Department of Agriculture and State agencies. By invitation of Director I. B. Johnson, of the South Dakota Experiment Station, and Assistant Director Gould, of the Nebraska Extension Service, O. & M. Director G. W. Lineweaver, Washington, and O. & M. Supervisor John Spencer, Denver, and Ed Landerholm, Billings, were at Lincoln and participated as consultants in developing cooperative programs. Representatives of various agencies of the Department of Agriculture were also present. The results of the Lincoln conference will have far-reaching effects on the cooperative program of the Bureau of Reclamation in the Missouri Basin.

Construction Program (Continued from page 178)

REGION IV (*continued*)

Tunnel; construction one mile of steel pipe Salt Lake Aqueduct, Salt Lake County; work on three short tunnels and the upper 4½ miles of Salt Lake Aqueduct in Provo Canyon.

SCOFIELD: $21,000; Minor work on dam appurtenances and rights-of-way.

REGION V (Headquarters, Amarillo, Texas)

Colorado

SAN LUIS VALLEY: $621,000; anticipated start of clearing reservoir site for Platoro Dam and construction of temporary camp; prepare specifications looking toward starting construction on dam in 1949–50.

New Mexico

CARLSBAD (Rehabilitation): $100,000; start work on rehabilitation and improvement of existing project.

TUCUMCARI: $2,187,000; near-completion of canal and lateral irrigation facilities for Unit No. 6; 50 percent completion of canal and lateral irrigation facilities for Unit No. 7; build major drains.

Oklahoma

W. C. AUSTIN: $724,000; complete all construction of canal and lateral irrigation facilities. Build four main drainage canals.

Texas

VALLEY GRAVITY: $250,000; continuation of examinations and surveys.

Texas-New Mexico

RIO GRANDE: $578,000; complete Elephant Butte-Socoro transmission line; procurement of equipment for Alamogordo, Hollywood, Socoro substations, and Elephant Butte switching facilities; studies and preliminary work for future proposed construction.

REGION VI (Headquarters, Billings, Montana)

Montana

BUFFALO RAPIDS (second division): $48,000; minor construction work.

CANYON FERRY DAM (Missouri River Basin): $3,000,000; subject to review of feasibility under new appropriation language, start work on major storage, river regulating, and power producing dams in Missouri Basin Program.

FORT PECK: $2,944,000; continue construction of major transmission system from Fort Peck to Williston, S. Dak., and from Glendine to Miles City and related substations; continue work on tap lines and substations to serve rural cooperatives and irrigation pumping units; start work on tap lines and substations to serve additional rural cooperatives and pumping units.

LOWER MARIAS UNIT (Missouri River Basin): $775,000; preliminary construction on Tiber Dam. Completion by 1954.

MILK RIVER (Rehabilitation): $73,000; rehabilitation and improvement of early project.

MONTANA PUMPING UNIT (Missouri River Basin): $210,000; start construction on N Bar N Subunit, the first irrigation pumping unit adjacent to the Missouri River.

MOORHEAD UNIT (Missouri River Basin): $770,000; construction of camp and access road and start of work on Moorhead Dam in 1949.

SUN RIVER: $72,000; minor construction work on project.

YELLOWSTONE PUMPING UNITS (Missouri River Basin): $505,000; start construction on Savage and Cartwright Units. Completion of both scheduled by 1950.

North Dakota

BUFORD-TRENTON: $59,000; minor construction work on project.

CANNONBALL UNIT (Missouri River Basin): $680,000; complete preconstruction work and begin construction on Cannonball Dam. Start construction of camp and access road. Completion by 1952.

HEART RIVER UNIT (Missouri River Basin): $2,356,000; continue construction Heart Butte Dam on restricted schedule. Completion anticipated by Fiscal Year 1950. Start work on Dickinson Dam. Completion 1951.

TRANSMISSION LINES (Missouri River Basin): $1,482,000; major items in the transmission line program cover continuation of Williston-Garrison line and start of construction on lines to serve Heart River Pumping Plants in North Dakota.

North Dakota-Montana

MISSOURI-SOURIS UNIT (Missouri River Basin): $987,500; continue land classification surveys and other preconstruction work on North Dakota Division; begin work on main diversion dam on Missouri River below Fort Peck.

South Dakota

ANGOSTURA UNIT (Missouri River Basin): $3,180,000; continue construction of Angostura Dam on restricted schedule. Completion late in Fiscal Year 1950.

BELLE FOURCHE (Rehabilitation): $27,000; rehabilitation and improvement of early project.

REGION VI (*continued*)

GRAND RIVER UNIT (Missouri River Basin): $1,647,000; start construction on Shadehill Dam. Completion by 1953.

MOREAU RIVER UNIT (Missouri River Basin): $910,000; construction of Government camp and access road; start work on Bixby Dam.

Wyoming

BOYSEN DAM UNIT (Missouri River Basin): $5,535,000; continue construction on restricted schedule with major activity centering on railroad relocation. Completion 1952.

OWL CREEK UNIT (Missouri River Basin): $200,000; prepare plans and specifications and perform other preconstruction work necessary to start construction of Anchor Dam in 1949.

RIVERTON: $3,031,000; continue work on canals and laterals.

SHOSHONE: $1,639,000; continue work on irrigation and power facilities on Heart Mountain Division; completion of laterals in Ralston Area; substantial completion of Heart Mountain Power Plant and Switchyard and Heart Mountain-Garland transmission line.

Wyoming-South Dakota

BELLE FOURCHE STORAGE UNIT (Missouri River Basin): $550,000; build camp and access road; carry on preconstruction work on Keyhole Dam, with actual construction of dam programed to begin late in fiscal year 1949. Completion early fiscal year 1952.

REGION VII (Headquarters, Denver, Colorado)

Colorado

COLORADO-BIG THOMPSON: $20,000,000; Continue construction on Granby Dam, Pumping Plant and Canal; Horsetooth Reservoir and Feeder Canal; Estes Park Aqueduct and Power System; Olympus Dam; Colorado River Improvement; continuation various surveys.

NARROWS UNIT (Missouri River Basin): $1,650,000; start construction on Narrows Dam and railroad relocation; complete housing.

Kansas

CEDAR BLUFF UNIT (Missouri River Basin): $2,350,000; construction of Cedar Bluff Dam will be started; housing will be completed.

Kansas-Colorado

ST. FRANCIS UNIT (Missouri River Basin); $2,000,000; complete construction of Government camp at St. Francis, Kans.; start construction of Bonny Dam near Hale, Colo.

Colorado-Nebraska-Wyoming-South Dakota

MISSOURI RIVER BASIN TRANSMISSION LINES: $2,500,000; complete construction of Gering-Sidney line (Nebraska), Sterling-Sidney line (Colorado-Nebraska), Gering-Alliance line (Nebraska), Cheyenne-Sterling line (Wyoming-Colorado), Glendo-Lusk line (Wyoming); begin construction Fort Randall-O'Neill line (South Dakota-Nebraska), Sidney Substation (Nebraska), Gering Substation additions (Nebraska), Alliance Substation (Nebraska), Pine Bluff Substation (Wyoming), Casper Substation (Wyoming), Lusk Substation (Wyoming), Sterling Substation (Colorado), Sterling-Ogallala section of Sterling-North Platte line (Colorado-Nebraska).

Nebraska

BOSTWICK UNIT (Missouri River Basin): $2,670,000; assuming that the repayment contracts will be signed, construction on Superior-Courtland Diversion Dam, the Republic Diversion Dam and the Superior and Courtland Canals will begin.

FRENCHMAN-CAMBRIDGE UNIT (Missouri River Basin): $7,500,000; continue construction of Enders Dam and Reservoir, Medicine Creek Dam and Reservoir; complete construction of Cambridge Diversion Dam, first section of Cambridge Canal, Oxford Siphon; start construction of second section of Cambridge Canal, and Culbertson Dam; complete housing at Trenton, Nebr.

MIRAGE FLATS: $194,000; completion of the dam, main canal laterals, drainage system and headquarters building; Cottonwood Creek Siphon will be extended to prevent recurrence of recent flood damage.

Wyoming

GLENDO RESERVOIR (Missouri River Basin): $850,000; subject to agreement between Wyoming and Nebraska required by congressional appropriation language, start construction of project housing; begin construction of Glendo Dam. Completion is expected by 1952.

KENDRICK: $1,150,000; start clearing of Seminoe Reservoir; begin lining of main canal; Medicine Bow-Hanna and the Casper-Kortes Seminoe transmission lines will be completed; start construction Casper, Medicine Bow, and Cheyenne substations.

KORTES DAM AND POWERPLANT (Missouri River Basin): $4,235,000; construction of dam and powerplant will be continued; construction of permanent improvements including housing, roads, and utilities will be completed. 36,000 kw. power capacity is anticipated for Spring of 1950.

Wyoming-Nebraska

NORTH PLATTE: $350,000; rehabilitation and betterment construction being programed depends upon attitude of Districts to repayment plans. Studies for improvement of project will be continued.

U. S. GOVERNMENT PRINTING OFFICE: 1948

NOTES FOR CONTRACTORS

Contracts Awarded During July 1948

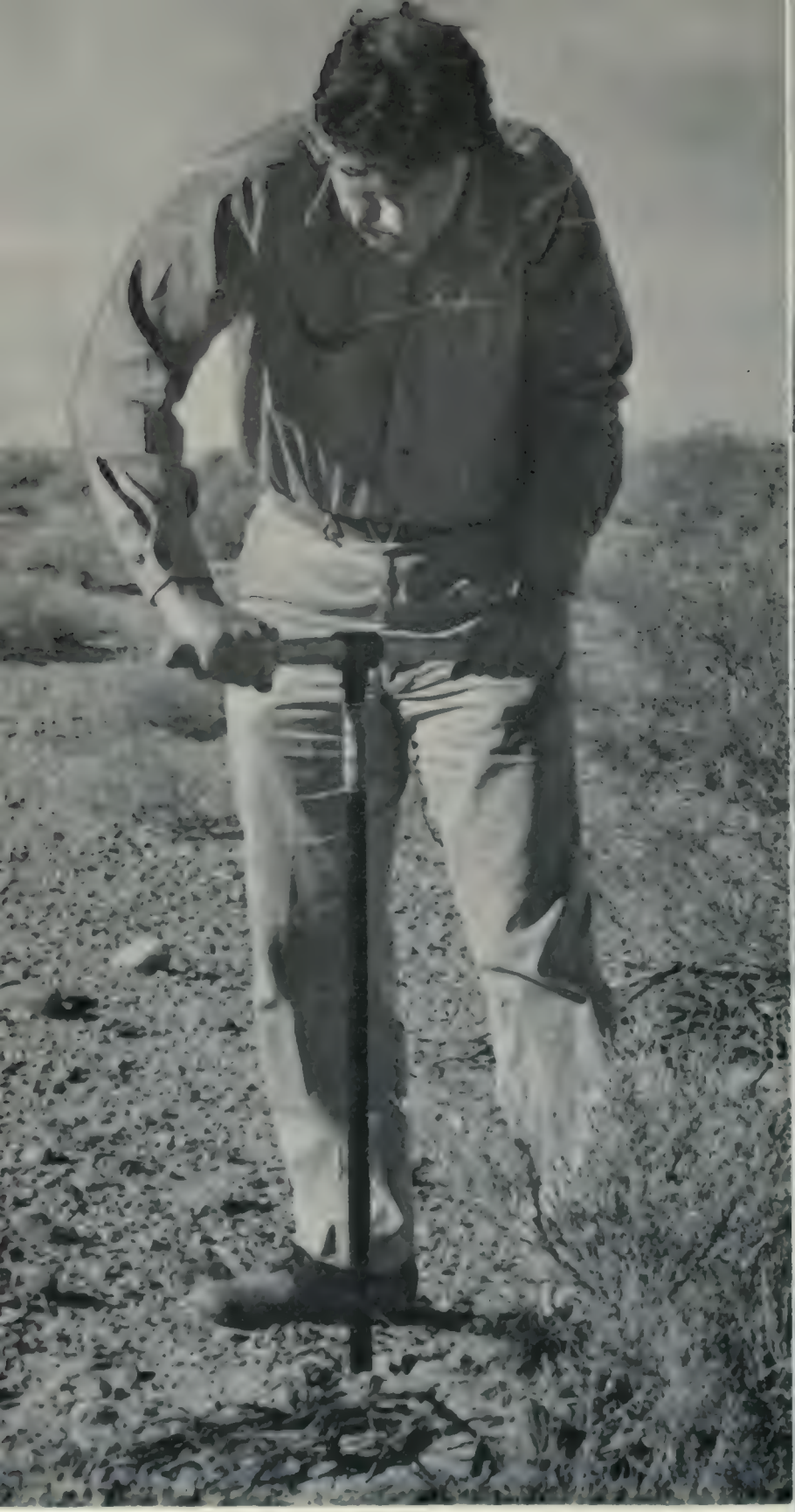
Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2148	Missouri Basin, S. Dak.-Wyo	July 27	Trashracks for canal outlet and river outlet works at Angostura Dam and main units at Kortes power plant.	Virginia Bridge Co., Denver, Colo	$45,492
2164	Fort Peck and Missouri Basin, Mont.-N. Dak.	July 9	Carrier-current telephone apparatus, coupling capacitor potential devices, and carrier-current line traps for Fort Peck-Williston, Fort Peck-Glendive, Glendive-Miles City, and Williston-Beulah-Garrison transmission lines.	General Electric Co., Denver, Colo	89,677
2175	Central Valley and Davis Dam, Calif.-Ariz.	July 23	Miscellaneous structural steel for Tracy pumping plant and Phoenix substation, schedules 2 and 3.	Golden Gate Iron Works, Inc., San Francisco, Calif.	26,949
2183	Yakima-Roza, Wash	July 15	Constructon of earthwork, pipe lines, and structures for lateral distribution systems, pump areas 2, 5, 6, and 7.	Goodfellow Bros., Inc., Wenatchee, Wash	181,788
2184	....do	July 15	Construction of earthwork, pipe lines, and structures for lateral distribution systems, pump areas 9A, 10, and 12.	John Klug & Co., Yakima, Wash	102,367
2203	Provo River, Utah	July 30	Construction of earthwork, canal lining, and structures for Provo reservoir canal enlargement, schedule 3.	Young & Smith Construction Co., Salt Lake City, Utah.	98,035
2216	Kendrick, Wyo	July 14	Construction of Seminoe-Casper 115 kv transmission line	Lewis Construction Co., Billings, Mont	65,447
2219	Hungry Horse, Mont	July 2	Construction of garage and fire station for Hungry Horse government camp, schedule 2.	Modern Construction & Fabrication Co., Seattle, Wash.	28,407
2226	Columbia Basin, Wash	July 12	3 unit substations for Grand Coulee Dam	Standard Transformer Co., Warren, Ohio	11,996
2230	Central Valley, Calif	July 22	1 pump gallery gantry crane for Tracy pumping plant	Judson Pacific-Murphy Corp., Emeryville, Calif.	25,208
2237	....do	July 21	One 100-ton traveling crane for Tracy switchyard, item 1	Moffett Mfg. Co., Albany, Calif	38,560
2239	Rio Grande, N. Mex.-Tex	July 16	One 2,300-kilovolt-ampere package type substation for Hollywood substation.	General Electric Co., Denver, Colo	48,744
2242	Columbia Basin, Wash	July 6	Structural steel for railroad bridges at west canal	American Bridge Co., Denver, Colo	19,915
2245	Colorado-Big Thompson, Colo	July 16	One 6,900-volt switchgear assembly for Estes power plant, schedule 1.	General Electric Co., Denver, Colo	45,005
2250	Columbia Basin, Wash	July 13	One 100-ton transfer car for Grand Coulee right power plant	Star Iron & Steel Co., Tacoma, Wash	15,500
2252	Missouri Basin, Mont	July 29	Three 1,250 kilovolt-ampere and one 15 kilovolt-ampere transformers for Forsyth substation, schedules 1 and 2.	Standard Transformer Co., Warren, Ohio	24,305
2253	Columbia Basin, Wash	July 19	One 75-ton traveling crane for machine shop at Grand Coulee Dam	Cyclops Iron Works, San Francisco, Calif	67,943
2256	....do	July 22	Three 25-by 25-foot radial gates for main canal, Long Lake headworks, item 1.	Pacific Coast Engineering Co., Alameda, Calif	19,140
2256	....do	July 26	Three 60,000-pound radial-gate hoists for main canal, Long Lake headworks, item 2.	Columbia Machine Works, Berkeley, Calif	19,725
2259	Colorado-Big Thompson, Colo	July 13	Clearing part of Granby reservoir site	Trione Contracting Co., Denver, Colo	193,340
2262	Newton, Utah	July 21	Construction of Newton Dam spillways	Thatcher Construction Co., Ogden, Utah	94,960
2291	Boise, Idaho	July 1	40,000 barrels of bulk portland cement for construction of Anderson Ranch Dam and power plant.	Oregon Portland Cement Co., Portland, Oreg	122,000
2303	Kendrick, Wyo	July 30	Constructing new Casper substation	Malcolm G. Long, Billings, Mont	79,762
VII-16	Missouri Basin, Kans	July 16	Constructing sewerage collection, water and gas supply lines, sidewalks, curbs, and earthwork for Government housing at Ellis, Kans.	John H. Keller Construction Co., Longmont, Colo.	12,933
VII-20	Missouri Basin, Kans	July 16	Furnishing and erecting 14 two-bedroom sectionalized, precut, prefabricated, or conventionally built houses for Government housing at Ellis, Kans.	Metcalf Construction Co., Omaha, Nebr	167,994

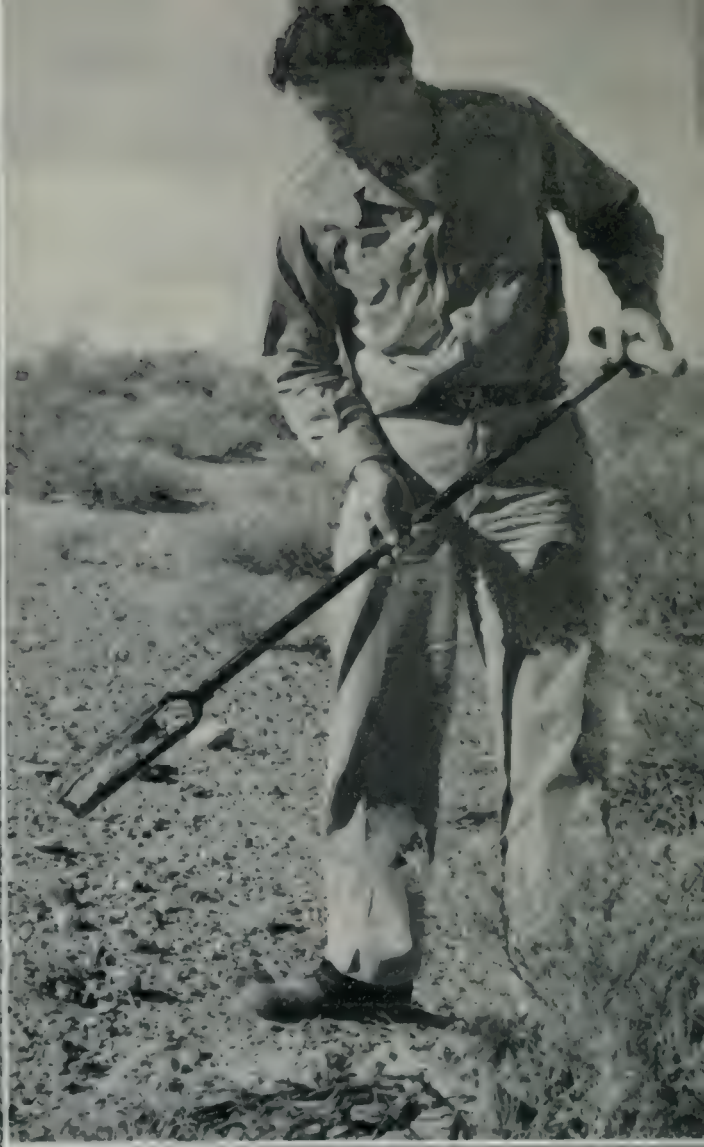
Construction and Supplies for Which Bids Will Be Requested by November 1948

Project	Description of work or material
Boulder Canyon-All-American Canal, Calif.	Pumping unit for Coachella Valley distribution system.
Central Valley, Calif	Construction of earthwork, lining, and structures for about 27 miles of Friant-Kern Canal near Porterville, Calif.
Do	Construction of earthwork and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Motor protective and grounding equipment for Tracy pumping plant.
Colorado-Big Thompson, Colo	Construction of 1,500 kilovolt-ampere Fleming substation near Fleming, Colo.
Do	Construction of 500 kilovolt-ampere Haxtun substation near Haxtun, Colo.
Columbia Basin, Wash	Generator voltage bus structure for units R7, R8, and R9, Grand Coulee power plant.
Do	Grounding equipment for station service unit LS-3, Grand Coulee power plant.
Do	Spare motor exciter set for Grand Coulee left power plant.
Do	Turbines and governors for Grand Coulee power plant.
Do	Water supply pumps for Grand Coulee Dam.
Do	Air vent siphon breakers for Grand Coulee pumping plant.
Do	Radial gates and hoists for O'Sullivan Dam.
Do	Construction of North Dam, an earthfill structure which is to form the north barrier of Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Davis Dam, Ariz.-Nev.-Calif	Construction of and furnish equipment for 15,000 kilovolt-ampere Blythe substation, located about 12 miles north of Blythe, Calif.
Davis Dam, Ariz.-Nev	Main control boards for Coolidge substation.
Do	Generator bus, protective and neutral grounding equipment for Davis power plant.
Do	Spiral stairways at Davis Dam.
Fort Peck, Mont	Construction of about 4.3 miles of 12.5-kilovolt wood-pole transmission line near Savage, Mont.
Do	Construction of 500-kilovolt-ampere substation which is to furnish power supply to Savage pumping plant.
Gila, Ariz	Pumping units for Wellton-Mohawk pumping plant.
Hungry Horse, Mont	115-kilovolt power transformers for Hungry Horse power plant.
Klamath, Calif.-Oreg	Rehabilitation and extension of laterals and drains near Tulelake, Calif.
Missouri Basin, Colo	4- by 4-foot high pressure gates for Bonny Dam.
Missouri Basin, Kans	Construction of Cedar Bluff Dam, an earthfill structure, about 136 feet high and 12,570 feet long, on the Smoky Hill River near Ellis, Kans.
Missouri Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior Nebr.
Missouri Basin, N. Dak	Construction of 1,500-kilovolt-ampere Watford City substation located near Watford City, N. Dak.
Missouri Basin, Nebr.-S. Dak	Construction of 50 miles of 115-kilovolt wood-pole transmission line from O'Neill, Nebr., to Fort Randall, S. Dak.
Missouri Basin, Wyo	Construction of about 1.5 miles of access road at Keyhole Dam about 18 miles northeast of Moorcroft, Wyo.
Missouri Basin, Wyo.-Nebr	Construction of about 170 miles of 115-kilovolt wood-pole transmission line from Casper, Wyo., to Gering Nebr.
Paonia, Colo	Enlargement of about 4 miles of Fire Mountain Canal, from present capacity of 70 cubic feet per second to a capacity of 200 cubic feet per second, located near Somerset, Colo.
Riverton, Wyo	Radial gates and hoists for Wyoming Canal.
Yakima, Wash	Construction of 63 miles of 34.5 kilovolt, 2.6 miles of 13.8 kilovolt, and 2.4 miles of 2.4 kilovolt wood-pole transmission lines.

NEXT MONTH—What the food processing business has done to boost irrigation farming and what irrigation farming has meant to the canning, processing, and freezing industries in Oregon. Written by Professor Ernest H. Wiegand, head of the Department of Food Technology, Oregon State College.

NEXT MONTH—The story of the Pacific Northwest Power Pool and how this huge cooperative venture has proved to be the "partner of irrigation" in the fast-growing Northwest section of the Nation. Written by Don Campbell, Regional Power Manager, Region I, Boise, Idaho.





SOIL SLEUTHING! Above we see the Iwan Type auger with 3" bit being brought into play for soil testing. The advantage of this type auger is that the soil removed is retained for examination in the "bucket" or opening immediately above the cutting edges. Many different types of augers are used, but all have one purpose—to examine the subsoil and find out what lies below the surface. While better data could be obtained by digging a pit with a shovel, this method would consume much more time and require the expenditure of much hard labor. Upper right: View of "bucket" containing gravely soil. Lower right: First-hand examination is made of sandy gravely soil contained in "bucket." *All photos by Wm. S. Russell, Region III, Boulder City, Nev.*

OCTOBER
1948

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"Invisible" Irrigation on Egin Bench
by F. M. Clinton

Shotcrete Canal Linings
by Thomas L. Steele

Agriculture and Food Processing in Oregon
by Ernest H. Wiegand

THE Reclamation ERA

Reclamation Place Names in This Issue

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Letters to the Editor

Re Visitors from Siam and Elsewhere

Assistant Commissioner Nelson kindly forwarded the following letter to our editorial office:

CAMERON COUNTY, BROWNSVILLE, TEX.,
July 9, 1948.

DEAR WESLEY: I read the July number of the RECLAMATION ERA with great interest—especially about the article from Siam.

I am sending a copy of this to the Denver office, and I would appreciate it very much if you would give me at an early date the number and names of the foreign countries that have sent their engineers to the United States to get a practical knowledge of reclamation.

(Continued on next page)

Reclamation ERA

October 1948 **Vol. 34, No. 10**

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

Did you know the Rio Grande Valley is good apple-raising country? This photo proves it. Here we see picker Peggy Jean Jarman in the midst of some choice harvest fruit on the Fort Sumner project, New Mexico. This photo was taken by A. E. McCloud, Region II photographer, when he was stationed at Region V.

OUR BACK COVER

"A THING OF BEAUTY . . ." Although East Park Dam, to complete the quotation, may or may not be "a joy forever" it has served the people of the Orland project in California since its completion in 1910. Teaming up with Stony Gorge Dam, East Park Dam on Little Stony Creek stores 51,000 acre-feet of water for irrigating about 20,000 acres of land. And its appeal is not only utilitarian, as this unusually striking photograph by J. E. Fluharty of Region II amply demonstrates.

LETTERS (Continued)

According to my best recollection, you had some 29 foreign countries who applied for permission to send their men here almost before the guns got cold on VJ-day and then they have been sending them all along.

Thanking you and with best wishes, I am,

Yours truly,

OSCAR C. DANCY, *County Judge.*

¶Reader Dancy was informed that a check of our records reveals that since the end of the war the Bureau has had visitors from 56 foreign countries. These visitors were principally eminent engineers employed by the governments of their own countries. Many of them have been government officials interested in conservation of water and natural resources. Others have been professors and educators from colleges and universities, and some have been engineers who have received degrees from American universities and colleges. In addition to the visitors, the Bureau has had trainees from 16 countries. These men, as did the group from Siam, spent from 4 months to 1 year with the Bureau working in the offices, laboratories, and on the job, gaining practical knowledge of the American way of engineering Reclamation projects.

The Bureau of Reclamation has been cooperating with the United States Department of State in aiding foreign countries to better their knowledge of engineering and reclamation so that those countries may enjoy higher economic and social positions through increased industry and food production. The Department of State has provided funds to the Bureau for aiding these visitors and it is hoped that greater assistance may be afforded them in the future.—Ed.

Niobrara—Not-So-Forgotten River

4131 NORTH KEELER AVENUE, CHICAGO 41, ILLINOIS,
August 16, 1948.

DEAR EDITOR: I was very much interested in reading in your July issue, the story of NIOBRARA—the "Forgotten River."

It happens that I spent many years of my younger life in the area covered by this story. As a young boy I went with my father and mother to Sheridan County, where we located and lived for several years, near Rushville. Later I spent many years at college in Neligh, and from there we often made trips to the Niobrara River.

Naturally, therefore, this story interested me in a personal way and I was very glad indeed to read it. My wife lived for many years at Ainsworth.

Very truly yours,

CARL D. THOMPSON,
Secretary, Public Ownership League of America.

He Came, He Saw, He Was Conquered

113 E. COLLEGE ST., CRAWFORDSVILLE, IND.,
July 12, 1948.

DEAR EDITOR: I am just back from a 1-month trip (3,800 miles) trailer travel survey of Reclamation projects in the West. I have been reading about reclamation for years and this gave me opportunity to see that it is all true.

In these days of doubt and suspicion and name-calling, when everyone is a little doubtful where we are going as a nation, the work of the Reclamation Bureau stands out as something without doubt American—in the true tradition of America—and in that nonpartisan spirit that has kept moving us forward to better the conditions of all, despite partisan politics, sectional jealousies and community arguments.

I have recommended the RECLAMATION ERA be added to the list of magazines for the Public Library, Crawfordsville, Ind., and for the Crawfordsville High School Library, Crawfordsville, Ind. Could you send a sample copy of the RECLAMATION ERA to these two addresses?

I am a G. I. looking for a place to invest in a farm. That was the reason for my trip.

Yours very truly,

L. L. PATTON.

¶ Glad to oblige reader Patton and hope Crawfordsville likes the ERA. We are encouraged by the growing number of subscribers outside the Reclamation area who are becoming more and more interested in the West, and its water resource development problems.—Ed.

California Comment

306 S. Union Avenue, Los Angeles 13, Calif., MAY 24, 1948.

DEAR EDITOR: I have enjoyed the Era very much and find it quite beneficial for those who are farming on irrigated land.

Very truly yours,

Miss JENNIE L. MCGOWAN.

Credit Correction

An error was made in allocating the photo credits on page 141 of the August issue, illustrating "Pioneer Pipeline." The photo of sprinkler-irrigated orchards was by B. K. Thomas, and the one of The Dalles, area by Stanley Rasmussen. Both of these photographers are Region I employees.

IT'S NOT TOO EARLY . . .

to begin thinking of your Christmas shopping.

Solve your gift problems by sending subscriptions to the RECLAMATION ERA to your friends. Each month they will be reminded of your thoughtfulness, and if you send your subscription in time, we shall mail a special Christmas Subscription Certificate to notify them of your gift. Simply fill in the blank below with the name of the person to whom the subscription is going, and add "Christmas Gift Subscription from _____" with your name clearly printed so that it may be inscribed on the certificate. Attach the names and addresses of additional persons to whom you wish to send the ERA as a gift to the blank with your remittance.

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(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of _____ for a _____ year subscription to the RECLAMATION ERA.

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"Invisible"

by F. M. CLINTON
Assistant Regional Planning Engineer
Region I, Boise, Idaho

(All photos by Philip Merritt, Region I)

View of main canal showing checks, turn-outs, and laterals. The water table in field stands at approximately the same level as water surface in main canal.

Simultaneous irrigation and cultivation at Egin Bench. Note the sandbag checks in the control ditch.

WHEN YOU SAY "IRRIGATED FARM," you generally think of a hard-working farmer standing in mud-covered rubber boots and armed with a long-handled shovel, guiding small streams of water down parallel furrows along which his crops are growing.

But that picture does not fit the 28,000-acre Egin (rhymes with "Legion") Bench in southeastern Idaho. There, strangely enough, irrigators don't use boots or shovels. They employ such an unusual method of irrigation that most people will not believe it until they actually see it done.

Egin Bench is situated on the west side of the Henry's Fork River near the town of St. Anthony in Fremont County, Idaho. The bench is the remainder of an alluvial fan of volcanic sand laid down on the lava plain by the Henry's Fork River when prehistoric glaciers were melting. It has an unusually smooth surface, which slopes uniformly downstream and toward the river. The deposit of volcanic sand tapers from a depth of about 50 feet along the edge of the terrace overlooking the river to a featheredge on the west side where the lava rock is exposed on the surface. This mass of sand is covered by a thin layer of wind-deposited soil similar to that covering the lava beds throughout most of the Snake River Plain, except that here it has been mixed with the underlying sand.

The history of this unusual project dates back to the 1890's when the first settlers built a canal from the Henry's Fork River and attempted to surface-irrigate the land on Egin Bench in the conventional manner. The water percolated into the porous soil and subsoil so fast, however, that it was impossible to get a normal head of water across even a small field. This operational difficulty was disheartening in itself, but discouragement became widespread among the settlers when they found that crops did not grow as they should even where the soil had been kept wet.

Although many tracts were sold for a pittance or abandoned during this trying period, the continued application of water by a few of the more determined settlers resulted in raising the water table to the ground surface in a few places near the main canal. Contrary to expectations, it was found that crops flourished in these "seeped" areas.

Greater efforts were then made to raise the water table to the surface over a larger area by operating the main canal during the winter and increasing the rate of percolation. The latter was accomplished by constructing five more large canals from the river and utilizing every available "ponding" area where a pond of water could accumulate, either by means of a natural depression in the earth or by constructing small levees. The water table was eventually raised to the surface throughout the bench and the cultivated area was stabilized at the present 28,000 acres.

Although the benefits of subirrigation were thus discovered by persistence and accident, this peculiar method of irrigating has now been practiced successfully for almost half a century on Egin Bench. Throughout the years, the farmers on the bench have reverently referred to the water table as the "sub."

The "sub" is allowed to drop about 20 feet below the ground surface in the center of the bench during the winter. Heavy diversions begin in the spring as soon as the ice in the canals has melted, usually about the first of April, and the "sub" is raised to within a few inches of the surface by about the first

Irrigation on Egin Bench

of June. During that period, the percolation of water to the underground reservoir is accelerated by filling all available "ponding" areas and by running water through small ditches across the fields, which are known locally as control ditches. In fact, water is seen almost everywhere **except** in the cultivated fields, farmyards, and roads.

After the "sub" has been raised to the desired level, the flow in the main canals is reduced somewhat and the stage of careful regulation begins. During the remainder of the growing season, the "sub" is held within 6 to 18 inches of the ground surface, depending on the type of crop being grown. During this period, the operation of the control ditches is all-important because they serve as the final adjusting valves which the farmers use to control the "sub" in the fields.

The control ditches are spaced about 35 crop rows apart in the center of the bench, but are as close as 16 crop rows apart near the edge of the bench where the "sub" is more difficult to hold. Only a small amount of water enters the control ditch and the water level is controlled by one or more sandbag checks spaced according to the slope of the field. The ideal manner of operation is to keep the flow at the inlet equal to the percolation along the length of the ditch, so that no water spills over the last sandbag check or out of the end of the ditch. Often a farmer will subirrigate only a part of his field by stopping the flow at a strategically placed sandbag check.

The flow of water in the main canals is regulated by a ditchrider, whose job is radically different from that of his co-worker on a conventional irrigation system. Essentially he is operating a huge ground-water reservoir, the level of which is very sensitive to the slightest changes in the rate of inflow and outflow. The variables in his equation are precipitation, evaporation from the soil, and consumptive use by crops and other vegetation. Errors on one side mean flooded fields, farmyards, and roads, while those in the opposite direction result in wilted crops. Either can happen in a matter of hours.

To maintain the required fine balance, the ditchrider keeps a wary eye on the weather and works closely with the farmers who are constantly watching the "sub." The ditchrider does not allocate, measure, or check the water used in the control ditches. From the main canal headworks to the inlets to the control ditches, there is a noted absence of padlocks on the gates and checks. This is the typical aspect of the community cooperation practiced and respected by the watermaster, ditchriders, and farmers alike.

The farmer on Egin Bench is seldom seen wearing rubber boots or carrying a shovel. His irrigation job is confined almost entirely to regulating the inflow to the control ditches in his field. He cooperates with his neighbors in regulating the inflow to the laterals and "ponding" areas in the vicinity of his farm. About the only manual labor involved in irrigating his field is the removal of weeds and trash which occasionally lodge in the control ditches. Occasionally the water must be turned out of the control ditches so they can be plowed to break the crust along the banks and loosen the bed to increase the rate of percolation.

Irrigation does not interrupt cultivation of fields as is the case where fields are surface-irrigated. Even the row next to the control ditch can be cultivated at any time the farmer chooses. Farm machinery can be operated in the fields at

any time, even though the water table is standing within a few inches of the ground surface. Barnyard manure is used almost exclusively for fertilizing because it increases the humus in the soil and acts as a binder to keep the sandy soil from blowing when the surface is dry.

The principal crops grown on the bench are, in order of percentage of cropped area, potatoes, alfalfa and clover hay, small grains, sugar beets, and field peas. The cropping program is closely tied to the livestock industry, in which many of the farmers are engaged; and large numbers of range cattle and sheep are fattened and fed during the fall and winter. Egin Bench is now one of the most prosperous farm communities in Idaho. The many modern and well-kept farm homes on the bench furnish ample proof of prosperity.

The process of subirrigation on Egin Bench requires relatively large quantities of water because of the very porous nature of the underlying formations in which the abnormally high water table is maintained. The formation is similar to a leaky tub filled with sand. Approximately 390,000 acre-feet of water is diverted onto the bench from April 1 to December 1, with the peak diversion by all six canals reaching 1,450 second-feet about June 1. A base flow of about 170 second-feet is maintained in the canals during the winter months of December, January, February, and March.

Thus, about 15 acre-feet of water is diverted annually for each acre of cultivated land on the bench. Of the total of 420,000 acre-feet diverted annually, about 11 percent is consumed by crops and about 15 percent returns directly to the Henrys Fork River. The remainder joins the large underground flows moving westward beneath the Snake Plain which are contributed by seepage from the Snake River channel and by streams discharging onto the plain from the mountains on its northern border, and which rejoin the main stream in large part about 180 miles downstream in the famous Thousand Springs of the Snake River Canyon.

The addition to this natural underground movement contributed by irrigation of the Egin Bench, however, has been responsible for the interesting development of another irrigation project on the Snake River Plain around Mud Lake, a natural depression in the lava fields about 25 miles due west of the bench.

Prior to 1900, Mud lake was an intermittent pond that impounded flood waters from Camas Creek in the spring and was often reported dry in the late summer. Ground water stood at more than 100 feet below the lakebed. Soon after subirrigation was practiced widely on Egin Bench, the water table rose to the surface in the Mud Lake area and many springs appeared around the lake. Geologists who have studied the area have attributed this rise to the fact that the underground outlets south of the lake did not have sufficient capacity to carry the additional water arriving from Egin Bench.

This great and progressive increase in the visible supply of water in Mud Lake attracted wide attention and resulted in the promotion and development of several irrigation systems. Unfortunately, the rise in groundwater levels was accompanied by a cycle of above-average rainfall and surface inflow to the lake. As might be expected, the unusual optimism on the part of the promoters resulted in the construction of canal systems to cover a far greater acreage than could be dependably watered during normal climatic conditions.

After the surface inflow to the lake practically ceased during the drought of the 1930's, ground-water pumping was resorted to in order to supplement the water supply available from the lake. Decreed water rights and fear of another drought have since stabilized the irrigated area at about 30,000 acres. About one-fourth of the water supply for this acreage is now drawn directly from the lake and the remainder is pumped from shallow wells around the north shore line with lifts ranging from 10 to 25 feet.

A casual trip over Egin Bench and across the desert to Mud Lake will not reveal the above-described unusual ground-water conditions. If the traveler happens to stop and visit with an old-time farmer on the bench, however, the conversation will soon drift to water and before long, the story of the "sub" and its effect at Mud Lake will be told. A tribute is due those pioneers who developed the bench and mastered the vagaries of ground water in the porous lava plain and put it to work. The present economical use of the ground-water resources moving beneath Mud Lake is due to their experimentation and perseverance. THE END

Excavation Work Started on India's Tungabhadra Project

According to a report from the consulate general, Madras, India, dated January 7, 1948, the Tungabhadra Dam project in South India is now out of the planning stage. Rapid progress is being made in the excavation of the dam foundations. Illustrations clipped from the *Madras Information*, an official publication of the Government of Madras, showed an excavated reach of the Tungabhadra canal, the Honorable Minister of Public Works inspecting the dam site and distributing sweets for children of laborers in the Tungabhadra area, blasting and concrete work, and thousands of laborers busily engaged in ground work.

Nearly 5,000 laborers are working at the dam site. According to the captions of several illustrations, many of these are Burma evacuees. The depth of necessary excavation varies from 17 to 70 feet. Rock spoil from the excavations is being partly carried away by rail to be used as railway embankments. Quarters for the engineers, clerks, and laborers engaged have been erected.

According to *Mysore Commerce*, the journal of the Mysore Chamber of Commerce, Bangalore, Mysore State, the whole project will cost $60,000,000 and, according to schedule, will be completed in 1953. The dam proper will cost $21,000,000, the canal system $18,000,000 and the power plant and accessories another $21,000,000.

The project is expected to irrigate 300,000 acres in Madras Province and some 600,000 to 700,000 acres in Hyderabad-Deccan. Only 10 percent of the area covered by the entire project is expected to be devoted to rice and vegetable production. The rest will be utilized for dry crops such as millets, cotton, and peanuts.

It is hoped to grow long-staple cotton in this area to replace cotton presently imported from Africa to supply the Indian textile industry. A variety of such staple cotton suited to this area has already been developed through experimentation. The black cotton soil of this area is expected to yield 1,200 pounds per acre under controlled irrigation.

WOLF POINT —city of destiny

by DONELLA M. RUSH, Clerk-Stenographer

EDITOR'S NOTE: This article has been written to acquaint the different regions of the Bureau of Reclamation with Wolf Point, Mont., former field headquarters for the Missouri-Souris unit, Montana division. Wolf Point is now the suboffice reporting to the Missouri-Souris' present headquarters located at Minot, N. Dak.

ABOUT A MILE AND A HALF southwest of the present town of Wolf Point, where Wolf Creek joins the Missouri River, stood the original Assiniboine Indian village of about 3,000 now commonly known as Oldtown. The village was located on a point of land, now eroded away, which formed a convenient landing for boats coming up the Missouri River. This became an important stop as a wood station, a place where the hunters and trappers stacked the hides of the countless gray wolves they killed, so numerous they attracted much attention through successive seasons. One winter these hides froze before they could be loaded to the trading posts and had to be left until the coming of spring. This pile was so high it became a landmark for miles around and was known as "the wolf point."

By 1884, most of the buffalo had been killed and the Indians had established homes in permanent villages. Farming was in its initial stage and most of the work was done by the Indian women.

The Presbyterian Mission Board established a school for the Indians in 1883, teaching them to read and write in their own language or English, and instructing them regularly in Bible knowledge. Up until this time the Indians worshipped the sun god and the thunder bird.

Teaching the Indians was uphill work. However, a free lunch was served at noon, and as it was a period of hard times for the tribe, at least the morning attendance at the school increased.

Gradually, through the children, the mission and teachers reached the parents, instructing them also. Redstone, chief of the tribe, was a kind and peaceful man. Although he could neither read nor write, he encouraged his people to respond to the white man's teachings. The school grew and more money was granted for new buildings. Dormitories were built and the children lived at the school, each family supplying its own children with fuel, food, and clothing. The girls were taught general housework, and the boys cared for the dormitories, schoolrooms, and stock. In 1930, as public schools were established, these mission buildings were either torn down or moved to the present townsite and Indian schools were started at the Agency in Poplar, Mont. The restless Missouri gradually crept closer and closer to Oldtown until the buildings were no longer safe.

Pioneers started settling in 1885. Sherman T. Cogswell established the first trading post in Oldtown. He was joined in 1889 by his sister Alma, who became the first white woman settler. Miss Cogswell, today, is living in California at the age of 90.

Although the Assiniboine Indians were a friendly peace-

loving tribe, the settlers could not easily forget the graves across the Great Plains of immigrants who had come to their death at the hands of hostile Indians. Not many years past the Custer Massacre had taken place. At Fort Keogh, approximately 224 miles south, the Second Infantry fought the Sioux and Cheyennes through the winter of 1876-77. The Nez Perce Indians in northern Idaho were at war, so a heavy stockade was built around the trading post. It is no wonder that women and children shivered with fright when curious Indians would peer through cabin windows.

The coming of the railroad was a great event for the homesteaders. The first track was laid in July 1887, and a heavier, more permanent line was built in 1888. The railroad was built about a mile north of Oldtown and boasted of a box-car depot and a few log houses. The present town soon developed on this more favorable location.

With the coming of the railroad, large cattle ranches began to develop around Wolf Point. One of the larger was the N-Bar-N Ranch, located south and west of Wolf Point. The range land for the N-Bar-N extended from the Canadian border to the Yellowstone River, a distance of about 180 miles. In 1908, the company owning the N-Bar-N Ranch constructed ditches, still in evidence, for irrigation purposes. Centrifugal pumps of the old, inefficient type, extremely large and cumbersome to handle, were shipped in, and Diesel motors were purchased to power the pumps. Old-timers enjoy telling of the first irrigation effort. As the story goes, the motors were started and water flowed into the canals. Soon they were filled, and the pumps continued to labor. Suddenly there was too much water for the canal to carry. It came back, washing the engine and pump into the river. This ended the irrigation efforts at that time.

From 1912 to 1914, Wolf Point was a boom town. Two banks, three grain elevators, four lumber yards, an electric light plant and a flour mill were built. A newspaper was established. In 1914, the Fort Peck Reservation land drawing was held and by 1917 the reservation was "settled up."

In 1914, all the principal business buildings on the north side of Main Street burned and it was with difficulty that the frame buildings on the south side were saved. A few days after the fire, one of the businessmen whose building was destroyed erected a shack with the sign "Slightly disfigured but still in the ring." In that spirit the businessmen rebuilt larger buildings with fireproof walls.

In 1915, Wolf Point was incorporated and the first town election held.

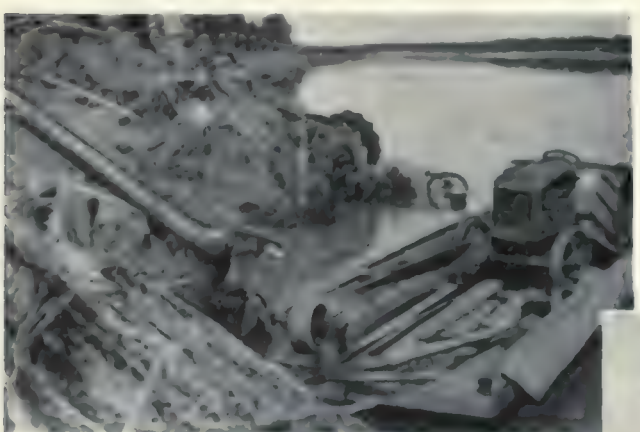
The second Wolf Point boom started in 1917. The prairie clouds were generous, giving the grain sufficient moisture, and yields were heavy.

In 1919, Roosevelt County was created. Through the perseverance of Wolf Point people their town was selected as county seat. There have been several battles over this issue since then, but Wolf Point has managed to retain its status. In 1940, a new two-story courthouse was built, in which the Bureau of Reclamation has its offices which take up almost the entire court house basement.

Present-day Wolf Point boasts of beautiful residential districts with paved streets, modern stores, and two airports; $50,000 is being spent for improvements on the town's largest, 117-room hotel. An $80,000 laundry is being constructed. A temporary 30-bed hospital is being redesigned from Government baracks at a cost of $50,000 and the finest equipment available has been purchased, while plans are being made for construction of a $150,000 fireproof hospital building. A $450,000 public school has been proposed.

A. V. Appelgren, now one of the directors of the Missouri-Souris Projects Association, was one of the first farmers to experiment with irrigation. In 1920 he purchased one of the old 6-inch pumps used by the N-Bar-N Ranch, and a 10-horsepower engine. This made a nice irrigation set-up for strawberries and a garden. The garden was so successful that an attempt was made to irrigate alfalfa. Because of an insufficient water supply, another 6-inch pump was purchased and a tractor was used for power. This seemed ideal until the June raise occurred. A tremendous flow of water came down the river, washing the river bank away,

(Continued on page 209)



Above: Mute evidence of "too much irrigation," at the old N-Bar-N Ranch. At right: Leslie Fourstar, early irrigationist near Owego, Mont.

Irrigating the Sahara Desert

by A. E. Place, Consulting Mining Engineer

Fantastic? French engineers and officials no longer scoff at Justin Savornin's theory as work goes forward to provide new homes for 1,500,000 people in the oases of the North African desert

One of the largest and least known new irrigation projects is that of the French Colonial Ministry to bring artesian water to extensive tracts of wasteland in the Sahara Desert of North Africa. They plan to create 1,500 new oases in the midst of barren, burning sands; to extend the irrigated areas of present oases and to populate the desert with an additional 1,500,000 inhabitants.

Preliminary work has been started in the Moab Valley, where 200 new oases have been laid out on a strip of land 200 miles long and 5 miles wide. A new town has been built at El Fayan, where selected natives are being trained to supervise and instruct the coming inhabitants in the art of irrigated farming, and in organized peaceful cooperative effort. This will be something new to the restless desert tribes. They have followed ancient patterns of existence from before the days of Abraham and Moses; their customs have involved bloody tribal feuds; raids upon their neighbor's herds of goats and sheep, camels, and horses; the strong took from the weak by force, and peaceful possession of land and home depended upon the favor and protection of some powerful desert sheik.

Each new oasis will have a village. They will all be alike and will provide, to begin with, for 200 families, or about 1,000 inhabitants. There will be a central square which will contain the artesian well or wells, with the pumping plant and distribution system. A mosque, a market, an assembly hall, and a public school, as well as a restaurant and a lodge will care for the community life. An administration building, equipped with post office, telegraph, telephone, and radio facilities will house the Government officials. The villagers will live in prefabricated houses, set up along wide streets. Each family is to receive 1 hectare, or 2½ acres, of irrigated land, upon which the Government will plant 120 date palms of chosen varieties. While the trees are maturing, which takes a number of years, other crops will be sown between the rows. The dates are to become the money crop and be exported. Good roads for automobile traffic will connect the strings of oases and give access and outlet. Railways

have been surveyed to central points, and shops and industrial establishments will follow. Where the artesian waters do not reach the surface they expect to put in power plants to generate electricity for operating deep well pumps.

The French, who know the character of the natives, will not make outright grants of lands or dwellings to them. These will be leased, with the understanding that failure to cultivate or maintain a plot or home will cause the holder to forfeit his lease. As all transfers require Government sanction, schemers, who might accumulate more than their share of property, are barred.

Like many other big and useful projects, the plan to irrigate the Sahara Desert, and its inception in the face of great obstacles, was due to the knowledge, foresight and tireless persistence of a single individual, Justin Savornin.

He was a professor of geology, who lived and taught in the city of Algiers, in the French African Province of the same name. His specialty was the geology of the great Atlas range of mountains, which separates the Sahara Desert from the Mediterranean Sea, and his particular hobby was proving the hypothesis that the Sahara Desert was underlain in many regions with water that could be made available for irrigation. He concluded that a great part of the Sahara was covered at one geological period by an immense fresh-water lake, or chain of lakes, similar to the Great Lakes of North America; that these lakes with their shores and beds dried out and were later covered up by eruptive and other formations which now form the floor of the desert basin, and that they were sufficiently porous in texture to hold water which might be tapped for irrigation.

To prove his theory, Savornin spent years in making geological examinations of the rivers and water courses which flow from the snow-covered Atlas Mountains south into the desert, where their waters disappear under the sands of their dry beds. Taking careful measurements, he came to the conclusion—

- that there was a water-bearing formation under much of the desert surface, about 600 feet thick;
- that this stratum held the underflow from the Atlas watershed;
- that water-holding beds extended south to the Sudan, and easterly to Egypt, dipping gently toward the Lybian Desert; and
- that they would be found there at a depth of 4,000 feet.

He claimed—

- that impervious layers below and above the water carrier prevented absorption and evaporation, and that there was no possible outlet or break which might drain it.

He also predicted—

- the existence of many rolls and anticlines that would bring water close enough to the desert surface to yield flowing artesian wells, and finally
- that loss through tapping on a large scale would not diminish the available water supply, as the latter would be annually replaced by the underflow coming from the Atlas Mountains.

Savornin was ridiculed and contradicted by other geologists and engineers. They called him an impractical dreamer. Government officials and private capital refused to aid him in his work. His copious reports and maps were pigeon-holed and forgotten. Years passed.

But when in recent times recurrent droughts in northern Africa began to dry up many of the ancient desert wells and oases, compelling large numbers of natives to abandon their ancestral homes, and crowd into the populous coastal plains of Tunis and Algiers, French colonial officials remembered Savornin's theory. They dug out his old reports and called him into consultation.

About 1931, two hydrographic expeditions were sent into the desert to prove Savornin's conclusions. They were failures. They did not drill deep enough.

Finally, in 1937, a third attempt was made by the colonial government near the town of Ghardaia with better equipment. This time the deep well drills tapped what appears to be an inexhaustible supply of fresh water at a depth of 1,500 feet. Subsequent drilling in other places not only proved the existence of Professor Savornin's underground reservoir, but delineated its vast extent. It was found to exceed in area all of France.

The government granted preliminary funds, and work was begun. They estimated 10 years necessary to finish the project, but war intervened, and everything stood still until recently. Now they are going ahead as fast as they can get the necessary supplies and equipment.

Justin Savornin has seen his theory vindicated and his dream materialized. France will not forget him. THE END

This article is based upon a report printed on page 9 of an independent Swiss weekly, published in Zurich, Switzerland, in German language, bei Sihl A. G., called Die Weltwoche, *of October 24, 1947. It is unsigned, but initialed M. C. Die Weltwoche. The original has been shortened, transposed, and modified by the author, A. E. Place.*

ADOLPH EDWIN PLACE is a consulting mining engineer who lives in Boulder City, Nev., but spends most of his time operating mines in Mexico and Central America. He was born in Hamburg, Germany, of American parents who were residing abroad for business reasons. He received a large part of his education in Germany and Switzerland, but graduated from the Massachusetts Institute of Technology in 1903 in civil engineering. He entered the Hydrographic Division of the United States Geological Survey in 1903, as engineering aid, was transferred to the newly formed Reclamation Service, and put on the staff of Cyrus C. Babb as assistant engineer in the Milk River project of Montana. In 1906 he resigned to take charge of a mine his father owned in Mexico. Here he founded the engineering firm of Place & Elton in the city of Oaxaca, operating mines for absentee owners. Selling out in 1911, Mr. Place took over the management of the Oaxaca state project to supply Oaxaca City with potable water and a complete drainage system. Driven out by the revolution in 1914 he joined the American Army forces invading the port of Veracruz, where he was employed as sanitary engineer and chief sanitary inspector under General Gorgas until the troops left. From 1916 to 1931 he maintained an office in Los Angeles as consulting engineer, and from then on he has operated and examined mines from Alaska to Central America. During the war he was employed by the United States Interior Department, Bureau of Mines, and later as shift superintendent at the manganese ore metallurgical plant in Henderson, Nev. When this was terminated he went back to his mines in the Republic of Mexico. Mr Place is married to Buenaventura Aispuro of Tamazula, Durango, Mexico. He is a member of the American Institute of Mining and Metallurgy, of the Mexican Geological Society and others.

SHOTCRETE Canal Linings

by THOMAS L. STEELE

Engineer, Branch of Operation and Maintenance,
Region III, Boulder City, Nev.

Call it pneumatically applied mortar, shotcrete or gunite, when it comes to canal linings, the Maricopa program presents an interesting study in efficient and economical operations.

DURING THE PAST SEVERAL YEARS the Maricopa County municipal water conservation district has faced a problem common to all other irrigated areas in central Arizona—not enough water. The district irrigates its 35,000 acres of land with surface water from Lake Pleasant on the Agua Fria River and also pumps from underground storage. Low run-off into the reservoir, together with excess pumping, led to a serious water shortage that shows little sign of easing up soon. As a result of this situation the district undertook a program of lining about 15 miles of canals and laterals to conserve all the water that would be available.

The Maricopa County municipal water conservation district is located some 25 miles northwest of Phoenix. Its headquarters are at Beardsley on its northern boundary. To the district's southeast is the Salt River project which is the Bureau of Reclamation's oldest development in the Southwest. To the south is the Roosevelt irrigation district.

District forces started work in the spring of last year, under the field supervision of H. S. Raymond, district engineer, and completed the job in the fall. W. W. Lane, the district's chief engineer, directed the program. About half of the lining was done on laterals that had been in use for several years, and the other half was on new construction. The old laterals had to be cleaned and reshaped before placing the lining.

Cleaning and shaping was accomplished by using a pull grader and a bulldozer or by a blade ditcher specially designed and built on the project. The blade ditcher consists of an 8-foot grader blade attached to each side of a crawler tractor. By running the tractor down the canal bank the

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Top photo shows blade ditcher designed and built by project forces. An 8-foot blade is attached to side of crawler tractor. Center: Placing 2-inch header board on each side of canal. Thickening each edge of lining to 2 inches gives strength to weak points. Bottom photo shows equipment, including water truck used for wetting ditch ahead of shotcrete placement.

Right: Placing 1-inch shotcrete lining. Nozzleman helper has hood end of spade with which reinforcing can be raised to approximate center of lining. ***All photos on this page by Harry W. Myers, Region III.***

The Pacific Northwest Power Pool

by DON CAMPBELL
Regional Power Manager
Region I, Boise, Idaho

A SUBSIDIARY AND SECONDARY PRODUCT of reclamation, hydroelectric power, sometimes referred to as the "partner of irrigation," has achieved a position of eminence in the fast-growing Northwest section of the Nation.

In this region, 150 electric generating stations are tied together by more than 1,600 miles of electrical transmission lines to meet ever-expanding demands for power for industries, homes, farms, and irrigation pumping.

The interconnected system is known as a "power pool." In simple words, a power pool is a reservoir of power-producing facilities operated on a cooperative basis in much the same manner as a group of farmers might operate a collection of farms for the purpose of obtaining maximum output or crop yield.

The Northwest pool is one of the largest in the country.

At the start of World War II, it became apparent in the Pacific Northwest that, in order to achieve maximum results in bringing the war to an early conclusion, all electrical resources would have to be "pooled" to meet the power demands for production of aluminum, lumber, airplanes, for ship construction, atomic energy research and resulting production, and for normal loads in the area. The Government, acting through the War Production Board, on May 1, 1942, issued what was known as General Limitation Order No. L-94, which required the integration of the operation of interconnected electrical systems. Even prior to the issuance of this order, some work had been done toward that goal.

As a result, all of the major interconnected electric utilities in the States of Washington, Oregon, Idaho, western Montana, and northern Utah, some 12 in number, were tied together electrically. The area served by the Northwest power pool comprises approximately 450,000 square miles, or roughly 15 percent of the total area of the continental United States.

The present total capacity of the utilities making up the pool is approximately 3,725,000 kilowatts, about one-half of which is represented by the Federal plants at Grand Coulee and Bonneville Dams, and five smaller plants of the Bureau of Reclamation. The maximum instantaneous load carried to date by the pool was 3,495,000 kilowatts, which occurred at 5:30 p. m., Pacific standard time, on December 10, 1947.

This huge load exceeded the maximum carried during the war, the area load having increased almost continuously since the pool was placed in operation, with the exception of a short period following VJ-day.

During the month of March 1948, the pool generation amounted to 1,898,688,000 kilowatt-hours, about 52½ percent of which was produced in the two Government plants at Bonneville and Grand Coulee. This output is slightly under 10 percent of the total output of all generating plants in the United States—20,788,000,000 kilowatt-hours.

The fact that the area served lies in two time zones, Pacific and Mountain, has been used to advantage in serving loads. Peak loads occur an hour earlier in the eastern section of the pool area and energy can flow from west to east to help meet this demand. An hour later when the daily peak occurs in

the western part of the area, the flow of energy is reversed and resources otherwise unused are made available in the eastern section to help carry coastal loads.

It was necessary to provide temporary interconnections for the purpose of making the combined output of all integrated plants available to serve loads. This made it possible, for example, to use surplus capacity available in Utah to serve new defense loads in the Seattle, Wash., area. In order to make the power pool function properly, it was necessary for each of the interconnected utilities to have contractual arrangements with other utilities which needed the surplus capacity.

The plan worked so well that it has been continued by mutual consent. It now saves large quantities of coal, oil, and water in the day-to-day operations of power producers.

The pool is operated by a small group of operating engineers, generally not to exceed two from each utility. These engineers have adopted a set of rules and regulations which are rather remarkable insofar as simplicity and number are concerned. Shortly after the first of each calendar year, the engineers meet and submit their estimates of the amount of load that their respective systems will be called upon to deliver during the coming year. Likewise, the load-carrying capability of the individual systems is estimated for the same period.

Those readers who are familiar with irrigation will recognize the term "critical water year." This term is also used in preparing the estimates of load-carrying capability since it is the only assured water supply that may be expected. On the basis of a critical water supply, the draft of water from reservoirs is scheduled so as to obtain as much hydro power as possible. Knowing this figure, the difference between the amount of load to be served and the amount of hydro generation expected, it is easy to see how much additional generation is required from other sources, principally steam. During the last few years, it has been necessary to further subdivide the steam requirements into two parts, that obtained from oil-fired plants and that from coal-burning plants. Estimates of the amount of oil available for power production are obtained and then the balance must be furnished from coal-burning facilities.

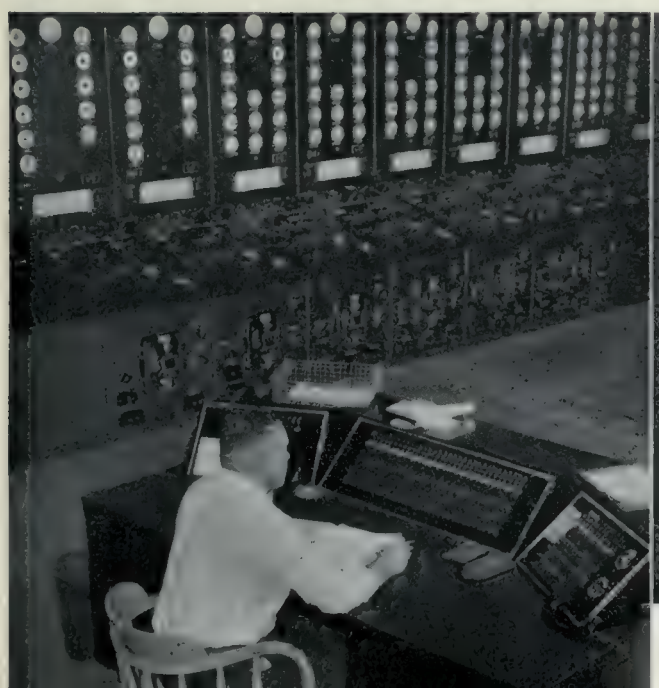
The pool operators also make allowances for water conditions which are better than "critical" in case that early guesses are too pessimistic, and in so doing are in a position to shift to a type of operation that will get the greatest output from the water available. The schedules which are prepared provide for the discontinuance of fuel-fired facilities in the reverse order of their efficiency, that is, the more costly plants are shut down first.

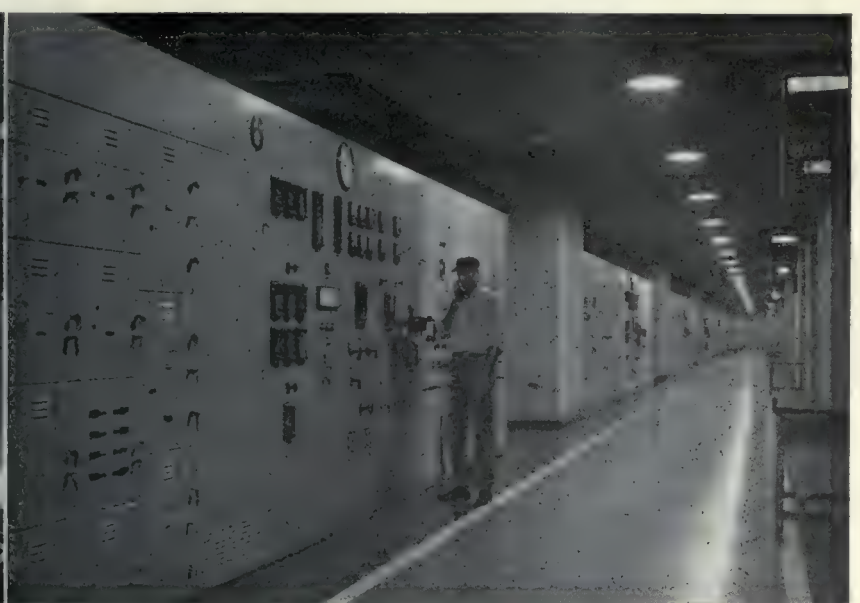
Another feature of the pool's operation which is of major importance is the "scheduling of maintenance outages." Electrical equipment, dams, penstocks, and other items require periodic maintenance work just as do automobiles if reliable service is to be expected from them. Normally, a utility does this type of work during seasonal periods of light load. It is obvious that if all utilities followed this procedure, it would be impossible to serve the load. Therefore, each pool operator submits a list of the work to be done, the time required, and the amount of the reduction in output involved for his particular system. The equipment outages are then scheduled and adjusted so that their effect on the load-carrying ability of the pool is a minimum. Through this type of advance planning, it is possible that the pool enters its maximum seasonal load period with all generators operating and in the best possible mechanical condition.

Through the efforts of "pool" operation, a more reliable service has been available to consumers in the entire Northwest, the use of critical materials, such as fuel, has been curtailed, and the construction of smaller, less efficient generator installations has been eliminated.

The operation has successfully avoided a "brownout" in the Northwest, such as was recently experienced in the Southwest, where lack of water seriously interfered with normal life of the area. Drastic curtailment of load has been

Lower left: Grand Coulee's control boards play leading role in Northwest power output. Directly below: Interior shot of Coulee power plant, showing governor gallery. Directly under the clock (left) is generator control board.





avoided in the Northwest as have minor inconveniences such as low voltage, slow electrically operated clocks, etc. With average water conditions in the next few years and with new installations of generation being brought in as scheduled, normal load growth should be taken care of. In the last 6 or 7 years, it would have been impossible to accomplish the results without the pool type of operation.

In the Pacific Northwest 487,000,000 kilowatt-hours were used in the production of aluminum in January 1945, the peak of wartime production. By April of 1947 peacetime production of aluminum had reached a level of 429,000,000 kilowatt-hours in the region. Other new industries have absorbed more than the difference between wartime and peacetime production levels.

Another important new load is on the horizon insofar as the Northwest is concerned, that of commercial phosphate fertilizer production needed to rehabilitate depleted and worn-out soils in the Nation. The only way in which this new load, estimated at 134,000 kilowatts in 1955, can be served is by the pooled type of operation described, as it is beyond the capacity of any one system to serve. THE END

CLIPPING FROM *"IN OUR OWN WORLD"—News and Comment, Especially 'Round About Central Washington and the Great Northwest.*

In November 1897 just 51 years ago, the Scientific American said, "America leads the world with a total installation of over 70,000 horsepower of electric energy. Switzerland next with 32,000. France 18,000, Germany 17,000 and Great Britain 4,000." Seventy thousand horsepower for the United States! Now we have one dam close to us capable of producing 300 times that amount and the time is not so far distant when the main Columbia will be producing 1,500 times as much as we were in 1897 over the entire United States.

In Chicago's World Fair days electric lights were becoming quite the thing in the cities. In the Chicago World Fair, too, was that Ferris Wheel 475 feet high, another gigantic piece of machinery, the result of man's imagination and ingenuity.

Most every community still has its "romancer" with imaginary ideas which he tells for facts. The old home community had one and the boys loaded up one for him about the Ferris Wheel. They told him the Ferris Wheel would be taken down and taken to Niagara Falls to be used as a giant water wheel for the development of electricity. That gave him a new one to palm off as a fact.

Supplemental Water

"And what is the baby's name," asked the minister softly.

The young father smiled proudly as he hoisted the little fellow upon his arm.

"Chauncey William Robert Montgomery Finley."

Up shot the minister's eyebrows, as he turned to his assistant:

"More water, please."

—From the ARMY AND NAVY JOURNAL

SAVING a SEGMENT

by Dr. JESSE D. JENNINGS

Archeologist, Region Two, National Park Service

About 80 percent of the clues to North America's buried history is found on the banks and in the flood plains of our watercourses.

Therefore, each dam or reservoir constructed for irrigation, flood control, navigation, or power automatically imperils scientific information about the historic and prehistoric Indians who inhabited this continent before the coming of the white man.

The present era of rapid development of our western water resources is no exception, and unless something is done, important segments of the pre-history of the West will be lost. However, because of the alertness of Government officials and members of the archeological profession, something is being done, particularly in the Missouri River Basin.

In the Missouri River Basin, at present, funds are made available to the National Park Service for recreational studies. A part of that recreational study involves an evaluation of archeological, historical, and paleontological materials. By agreement with the National Park Service, the Smithsonian Institution has undertaken the archeological survey of reservoir areas and has been on this job since July 1946 when funds became available. The resources of 50 reservoirs have been assessed. More than 500 sites, some of which are of great importance, have been discovered. These archeological and paleontological findings are being and will be, where appropriate, keyed in with the recreational proposals of the National Park Service.

Survey, however, is but the beginning of the job. Location is not enough. Some sites must be sampled, while some should be thoroughly excavated if adequate representative

Aerial photo showing general view of excavation activity being conducted by Smithsonian Institute on right abutment of Medicine Creek Dam site. ***Smithsonian Institute Photo.***

# of HISTORY

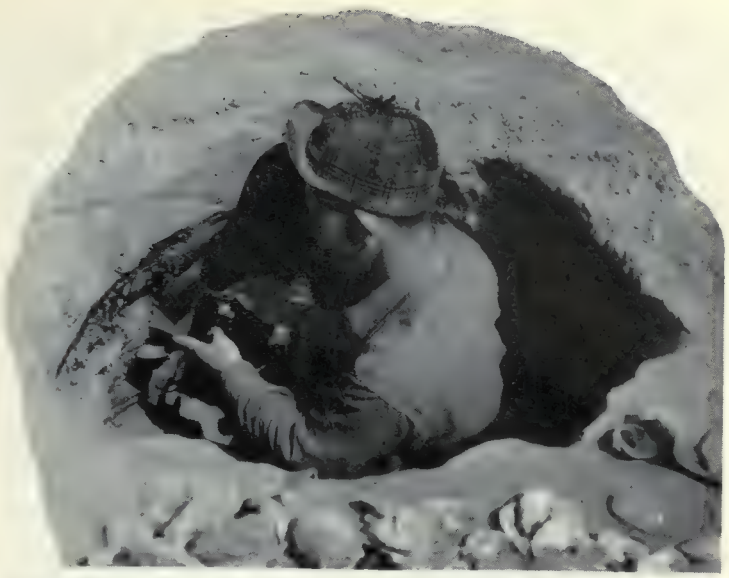
data is to be salvaged. Information recovered from reservoirs ahead of inundation enjoys several values. Primarily, of course, it will make important contributions to general knowledge of the prehistoric Indian cultures of the West. One unexpected benefit from archealogical work is a fuller knowledge of prehistoric climate and man's adaptation to climate. Tree ring calendars, and soil analysis, and recent geological phenomena are all specific basic data for climatological inferences.

Although the past 2 years of reconnaissance survey have taught us a great deal about the prehistory of the Plains, this information can be considered little more than suggestive. Excavation of key sites is the next phase of the program and is becoming an acute problem. Funds for the much more expensive work of excavation are difficult to arrange but in one very urgent case at Medicine Creek Reservoir near Cambridge, Nebr., money has been authorized for archeological search.

The valley of Medicine Creek is a treasure house of raw scientific fact. On Line Creek are Pliocene and Pleistocene quarries yielding many new fossil animal forms. At one such fossil site tools made by ancient man were found, together with extinct animal forms, beneath many feet of wind and water-laid soils. At other places in the reservoir, prehistoric villages of the Woodland (A. D. 1000) culture have been discovered. These Indians, although they made pottery, probably did not cultivate food plants but lived upon game and wild plants. There is no evidence that they made permanent houses.

But by A. D. 1300 or 1400 all the Medicine Creek Valley was densely populated by the Upper Republican people. These Indians lived in rectangular lodges built of timber and earth. They knew and practiced agriculture, so were not entirely dependent upon the natural foods. Their economy was rendered more stable by the cultivation of corn, beans, and squash. Their permanent dwellings formed irregular villages on the bluffs and terraces along the creek. Gardening was done in the flood plain of the stream.

After about 1500, the Medicine Creek region, as far as we know, was never again settled by permanent groups.

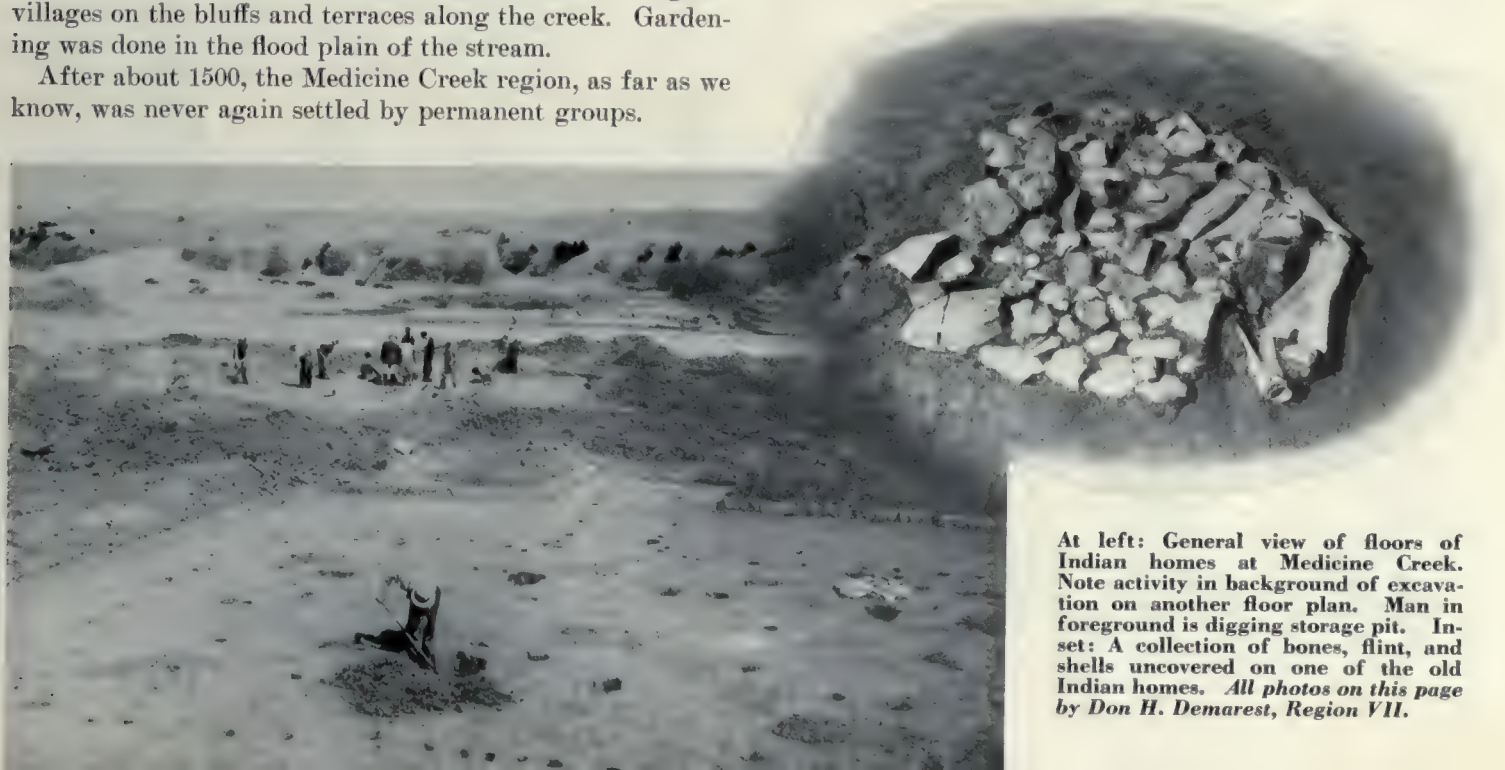


Close-up of storage pit at Medicine Creek Dam site showing worker uncovering a piece of pottery.

At present, the Smithsonian Institution is conducting full-scale excavations, with the aid of Bureau of Reclamation equipment and hired laborers, at the Medicine Creek Dam site in an effort to salvage representative data from sites in immediate danger of destruction by construction. The routine and continuous use of power equipment for the removal of overburden, handling spoil dirt, etc., constitutes an innovation in archeological excavations, so the dig is doubly important. If the use of such equipment proves feasible at Medicine Creek, we hope that the techniques developed there become routine throughout the Missouri River Basin.

Recent finds at Medicine Creek include numerous earth lodges, burials, fine large samples of long-discarded tools and utensils, and related materials. All these add up to a richer understanding of the life of the early settlers in the Medicine Creek Valley.

THE END



At left: General view of floors of Indian homes at Medicine Creek. Note activity in background of excavation on another floor plan. Man in foreground is digging storage pit. Inset: A collection of bones, flint, and shells uncovered on one of the old Indian homes. ***All photos on this page by Don H. Demarest, Region VII.***

Agriculture and Food Processing in Oregon

by ERNEST H. WIEGAND
Head, Department of Food Technology, Oregon State College

EDITOR'S NOTE: A leading authority on food-processing, Professor Wiegand describes the current status and future outlook of this industry in the State of Oregon. Readers will note that the author looks to expansion of irrigation in the Willamette Valley, Rogue River Valley, Deschutes area, and Umatilla County to pave the way for an extensive growth in the industry. The Bureau of Reclamation is making project and river basin studies in each of these areas. Professor Wiegand lists Owyhee and Vale Federal Reclamation projects as areas which make noteworthy contributions in crop production for processing.

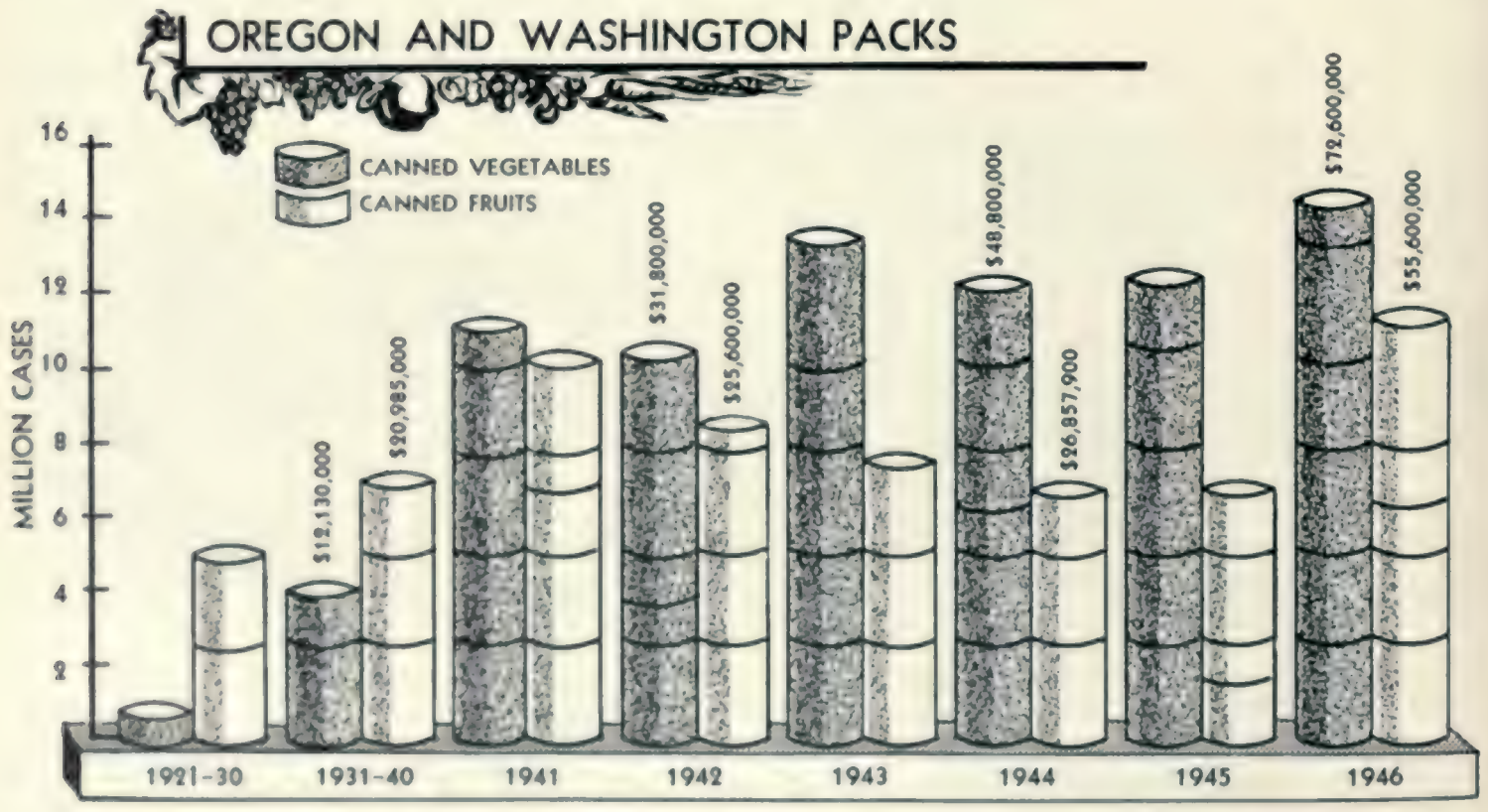
Agriculture has always been a basic industry in Oregon. Since early times the farmland has been important to the economy of Oregon people. Today the 63,125 farms are responsible for a high economic yield; in fact, in 1947 the cash farm income totaled $376,350,000.

There are several reasons for Oregon's success in agricultural pursuits. Her long growing seasons, wide range of soil, topography, and plentiful rainfall make possible many diversified crops. This diversity accounts for 242 different horticultural products grown or manufactured in the State—a record beaten only by California. Oregon growers market such specialty crops as peppermint, hops, flax, and sugar beets, with 12 different types of small fruits, 30 common vegetables, and all the well known deciduous tree fruits, walnuts, and filberts.

The fertile growing areas and the important food processing areas of the State have grown up together, each contributing to the other's prosperity. In the lush garden areas of Oregon, you can find canning, freezing, and dehydrating plants in profusion—especially in the valleys west of the Cascade Mountains. This area supports two-thirds of Oregon's 1,474,000 population and boasts of never having had a crop failure. Here you find the greatest diversification of crops, along with a temperate climate, and plenty of rainfall for three seasons of the year.

Oregon's "Garden of Eden" is the Willamette Valley which extends 150 miles along the Willamette River. The valley is neatly hemmed in by the Cascade Mountains on the east and the Coast Range on the west. About 70 percent of Oregon's total population live within this valley. Fifty percent of the State's farm population live here on 51 percent of the State's farms. The Valley's rich fruit orchards, berry farms, nut orchards, and truck farms account for the wealth of raw materials flowing into processing plants each season. Ninety percent of Oregon's small fruits come from farms in the Willamette Valley and are processed in canning and freezing plants in the area.

But don't overlook the valleys of southern Oregon. They are similar to the Willamette Valley in length of growing seasons, soil fertility, and moderate temperatures. The



Rogue River Valley, nationally famous for its luscious pears, also produces apples, cherries, strawberries, apricots, grapes, nuts and a large variety of vegetables. Prunes rank as the number-one fruit in the Umpqua River Valley, although other tree fruits and vegetable are also grown in abundance here. Fresh marketing of fruits, especially pears from the Rogue River Valley, has become an important business and has helped to spread the fame of southern Oregon's fruit.

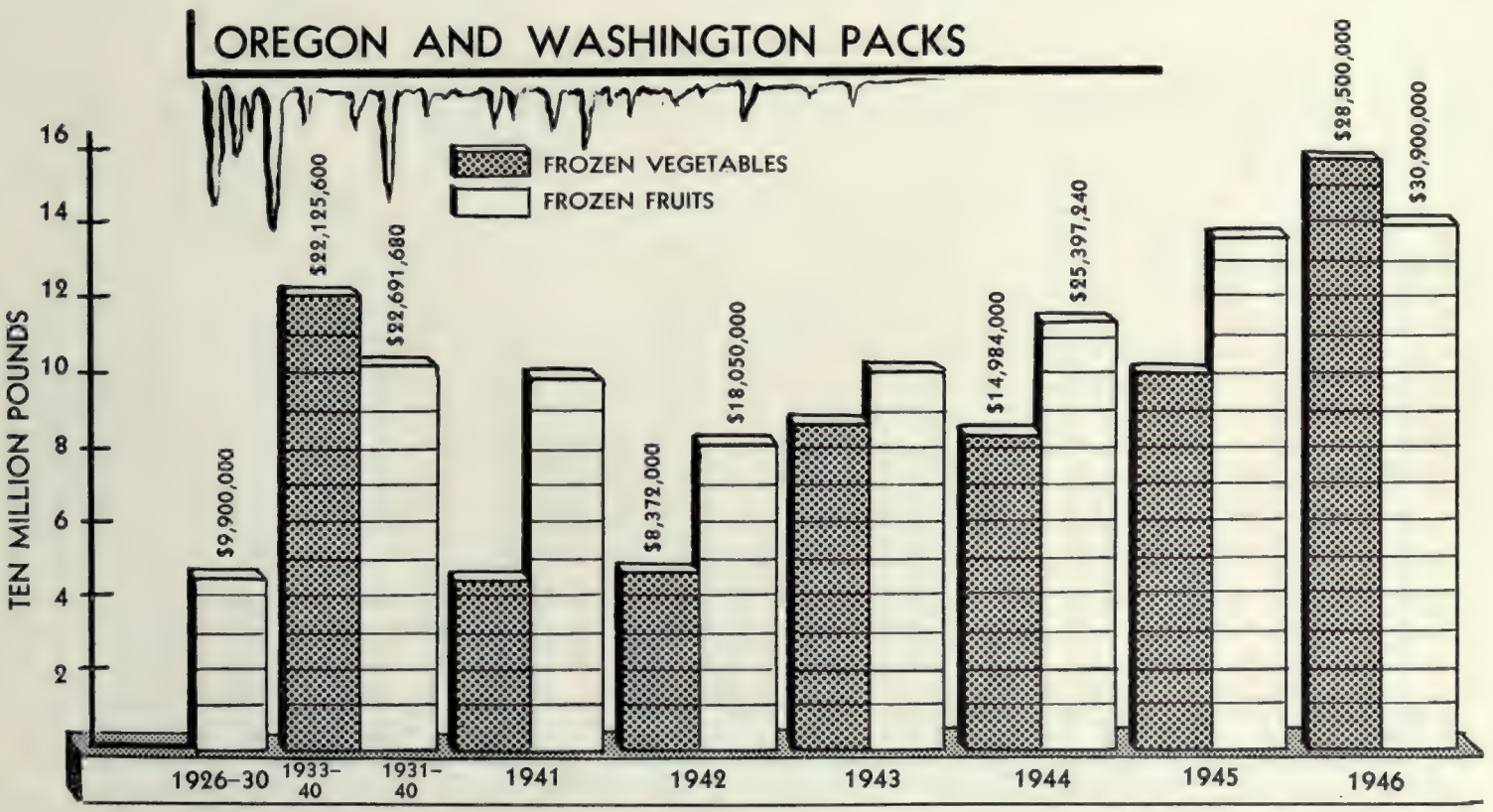
East of the Cascade Mountains stretch miles of semiarid lands and sagebrush where dry-wheat farming and beef-cattle raising predominate. For the most part, irrigation has turned these semiarid lands into growing areas with rich production of tree fruit and vegetable crops. Apples have long accounted for national and international fame for Hood River; however, pears have colored the picture in the past few years with expanding markets and ready sales. Cherries and strawberries come from Hood River farms, too, and go into both processing and fresh market channels. Irrigation in Umatilla County has provided a wide diversity of crops and has been responsible for the growth of large-scale processing operations here. Prunes and peas are processed extensively along with apples, cherries, and corn.

In the Snake River Basin of Oregon there are 185,000 acres of irrigated lands. This irrigation (on the Vale and Owyhee projects) has made possible the production of both tree fruit and vegetable crops on land which was formerly wheat and livestock country. Now apples, prunes, peaches, peas, and corn flow into processing markets for canning and freezing. Alfalfa, potatoes, and onions are also grown in this area.

Irrigation, important to Oregon's agriculture, has been carried on extensively in central Oregon and has made possible the increase of row crops of the region. By 1950 the North Unit of the Deschutes Federal Reclamation project is expected to provide water to 50,000 acres of land. Some of this area is already being served. Projected irrigation of 35,000 acres in Jefferson County, in which the North Unit is situated, will provide additional means to carry on intensive farming in the next few years. As more water becomes available, gradual changes in land use will occur which will greatly influence the agricultural economy of this section.

In 1946 there were 60,000 acres of irrigated land in the Willamette Valley, and within the next few years further irrigation is planned for this farm land. Umatilla County

This quick freezing plant in Ontario, Oreg., is a direct outgrowth of the increased vegetable production in the State during the past twenty years. Here, we see employees processing kernel corn for quick freezing. ***Photo by Phil Merritt, Region I.***



is scheduled for further irrigation developments, too, in the near future.

Oregon's horticultural products rank high among those of the Nation. In fact, Oregon ranks first in the production of winter pears, filberts, loganberries, youngberries, boysenberries, black raspberries, and gooseberries. Second place in the Nation goes to Oregon on strawberries, red raspberries, walnuts, prunes, and sweet cherries.

The most significant change in the acreage devoted to horticultural products—the transition from fresh-market production to production for processing—occurred between 1920 and 1943. As the number of acres destined for processing has grown, so have the national and international markets for the finished processed foods. Statistical studies show close coordination between production and market outlook.

Vegetable acreage, for example, has increased very rapidly during the past 20 years. This growth has been due to the canning and freezing industries, which in turn, have increased throughout the State. The gain in acreage is graphic and startling in implication. In 1930, some 7,630 acres were harvested for fresh market and 3,930 for processing. Ten years later (1940) some 12,740 acres were harvested for marketing, whereas 35,610 were harvested for processing. By 1947, about 16,620 acres were harvested for market—an insignificant figure, compared with the 75,000 acres harvested for processing.

Freedom from Crop Failure

The most dynamic increase has been in vegetable production, although farmers have produced more and more from trees, as well as small fruits. Oregon still leads the Nation in its production of many tree fruits and berries, and processing statistics mirror this lead.

Oregon, recognized as the source of high-quality foods, has long been a key State in the processing industry. True, she has considerable competition with producers closer to the big markets, but that problem is made lighter by several factors. The long growing season plus a wide choice of products, and comparative freedom from crop failures have made it possible for Oregon processors to compete at a lower cost. High-quality products, produced at a lower cost to both grower and processor, have helped maintain Oregon's lead.

The frozen-food industry, born and nurtured in the West, has shown very significant gains since its beginnings in 1918. Although the industry has spread to many parts of the United States, the three Pacific Coast States still account for much of the yearly production. The growth in Oregon and Washington, shown in the number of cases of canned fruits and vegetables and pounds of frozen fruits and vegetables, is depicted graphically in the charts. The dollar values of these processed foods are indicated on the charts, representing wholesale prices which the industry brings to the two northwest States.

With the world food situation as it stands today, there is every indication that the processing industries will grow even more extensively. Dehydration of fruits and vegetables, which boomed in Oregon during the war, has decreased significantly throughout the United States. However, increased production in the other processing fields offsets this change.

The brined-cherry industry in Oregon, not yet 50 years old, represents 7 million dollars to the State. Maraschino cherries, made from brined cherries, are manufactured outside the State, however. An all-time high was reached in 1946, when nearly 248,000 barrels of brined cherries were produced in the United States; of these, approximately 85,000 barrels were produced in Oregon.

The brined-cherry industry furnishes an example of the active interest and participation of the Food Technology Department at Oregon State College in Oregon's food-processing industries. Cherry growers came to the department, part of the agricultural experiment station, in 1925 when they were faced with a bumper crop of cherries—and no market. The growers and staff members of the Food Technology department got together, studied the situation, made their plans, and cooperated in solving the problem. The result of their joint efforts was the cherry-brining industry. The story of the industry in the past 23 years illustrates well the cooperative spirit between Oregon growers and the research staff in the Food Technology Department.

The early experiments in the frozen-food industry were carried on, in part, by the food-technology staff from the experiment station. Some outstanding work on dehydration during World War II was done in the department for the Army's Quartermaster Corps.

Continuous research projects are being carried on to solve new problems in the processing field—for canning, freezing, dehydration, and brining. New methods of food preservation are investigated which will enlarge the markets for Oregon's horticultural products. The project to develop new and better varieties of small fruits for canning, freezing, and preserving carried on in cooperation with the United States Department of Agriculture, has been actively studied for nearly 25 years.

One of the latest projects is to develop new uses for surplus filberts grown in Oregon. Already preliminary experiments have developed filbert butter, oil, flour, and press cake. Another laboratory study involves filbert shells and how they can be put to a profitable, money-making use.

There is a larger project for utilizing the otherwise wasted residue in the processing plants, including a study in which methane gas is produced from pear waste. This project, with all its possible ramifications, may mean a great deal to Oregon pear growers and processors. Utilization of other processing wastes may change the existing situation which canneries, frozen food plants, and cherry briners face each season. If they can make money even from the processing waste material, Oregon manufacturer may be able to compete more easily with eastern processors, as such an additional financial return will certainly influence the price of the finished processed foods.

Agricultural Oregon is a "horn of plenty" with many different crops grown on her farms. She is blessed with mild weather, plentiful rainfall, and long growing seasons. These factors combine with fertile soil to make possible the production of Oregon's quality tree fruits, vegetables, berries, and nuts. Farm production and processing go hand in hand, to make Oregon a leader in agriculture and in food processing. THE END

Hungry Horse Breaks "Fast"

"The Northwest is moving forward. The future is yours. Working together throughout the Columbia River Basin with a single plan in mind, we can make that future bright. For this is a land of destiny."

Spoken by Assistant Secretary of the Interior William E. Warne, simple, meaningful words these were. They expressed better than any other, the real sentiment of the people of Montana on July 10 when they forgot everyday cares and celebrated in rip-roarin' fashion the official start of construction of the multiple-purpose Hungry Horse Dam.

Joined by neighbors from surrounding areas, 6,000 Montanans came from all parts of the State to the dam site on a tributary of the Columbia—the South Fork of the Flathead River—12 miles from the west entrance to Glacier National Park. They had a great time. They were proud of what they had done. They agreed with "Bill," as Montanans called the Assistant Secretary, as he told them and a vast Northwest radio audience:

"The one resource that distinguishes the Pacific Northwest among all our western regions is the wonderful Columbia River. It provides at once both the opportunity and the challenge of this region. The Northwest will prosper, grow, and gain economic and political strength in direct ratio to the development of its great river."

The day was one of fun and good will, with an underlying serious tone that always attends events of historic significance. Everyone agreed, from little Johnny with his big balloon, to topmost officials—and there were many—that Montana did itself proud in celebrating the start of the $100,000,000 project.

Sponsors—the Flathead Valley Citizens Committee—appropriately called the festival "Northwest Progress" in full knowledge of the significance of the dam to the northwest country as a whole. How significant, was explained by both Assistant Secretary Warne and Commissioner of Reclamation Michael W. Straus. In the words of the latter:

"If we protect it, it will be serving the Northwest after everybody in Montana today is dead and gone—a hundred, five hundred, or a thousand years—as long as water runs downhill, perhaps forever."

The structure will be one of the great dams of the earth. It will produce 300,000 kilowatts of power at the site and in addition, will provide, through planned releases of water from its reservoir, additional stream flows which are needed at Grand Coulee, Bonneville, and other dams downstream to firm up the power outputs there.

As Bill Warne put it, "this power, of which there will be 700,000 kilowatts, is just as real, as valuable, and as useful as though it were generated here."

Furthermore, he added "a million acre-feet of water stored here when some future disaster threatens to sweep the valleys below will reduce flood heights all the way down to the Pacific, and when more dams are available, such peak flood storage promises to pacify the river and hold it within bounds. These results flow from unified operation of the system of dams."

Hungry Horse celebration heralding start of construction July 10, 1948—a dynamite blast set off by Gov. Sam Ford of Montana officially started construction. ***Photo by A. E. McCloud, Region II.***

Yes sir, July 10 was a day long to be remembered. It began with two bands and a cordial welcoming committee greeting the Bureau plane bringing Interior and Bureau officials, including Messrs. Warne and Straus and Chief Engineer Leslie N. McClellan. In the greeting group were Governor Sam Ford of Montana, Congressman Mike Mansfield, Regional Director R. J. Newell, Construction Engineer Clyde H. Spencer, Al Winkler, president, and Don Treloar, secretary, of the Flathead Valley Citizens Committee.

From the minute of arrival, there followed a rapid-fire succession of events, each designed in its own way to portray the enthusiasm of the Northwest, and particularly Montana, for the new project.

The climax of the day was the setting off of the blast marking the official start of construction in the spectacular and deep canyon of the South Fork by Governor Ford. Equally impressive were such events as the presentation of a historical pageant depicting the history and growth of Montana, a free barbecue for 6,000 people, and an Indian ceremony, during which Messrs. Warne and Straus were made members of the Blackfeet Indian Tribe and named "Medicine Eagle" and "White Beaver" respectively. No less enjoyable were the informal tours of Glacier Park, a buffet luncheon at Columbia Falls, and the dinners at Lake McDonald Hotel.

When the day was over and all the tired kids had been put to bed, many a Montana mother and dad gave a tired sigh that said "It's a swell world, after all." There were others, such as Winkler, Treloar, Leon Phillips, Gray Edmiston, and others of the Flathead organization which did so much to make the dream come true, who leaned back and already were longingly thinking ahead to another day, when they would gather again on the rugged South Fork, this time to celebrate the completion of the 535-foot high barrier. They're not short of vision in Montana. THE END

Shotcrete Canal Linings

(Continued from page 189)

blade can be manipulated so that it shapes the near bank. The same operation can be performed by the pull grader but more equipment and personnel are required. In addition to these pieces of equipment, laborers with shovels helped out in the final shaping and cleaning operations.

The objective of the entire reshaping operation was to provide a reasonable base for the lining with a minimum of expense. No attempt was made to finish the section to accurate line or grade, or to maintain a regular section. The physical result was a lateral that will satisfactorily perform its required function of carrying irrigation water. The economy is attested to in the final cost of the operation.

The new laterals were built by first preparing an even grade and roadway with a tractor and scraper, and then cutting the ditch with a tractor and blade. It is reported that by laying out the lateral line to avoid heavy cuts and fills, the costs of new construction were very little higher than costs for reshaping the old sections. The average section has a 2-foot bottom width, a 2-foot depth, and 1 to 1 side slopes.

After the canal section had been shaped, 2-inch boards were placed lengthwise along the canal on both sides to form the top of the finished lining. After the boards were in place, 4-inch mesh No. 11 wire was placed in the section, and a thickness of 1 inch of shotcrete was applied to the section for the top 6 inches on each side where the lining was flaired out to a 2-inch thickness at the edge. After the lining was placed, it was cured by spraying with Hunt process compound. The rebound was not troweled.

The entire operation for placing the lining was highly mechanized. A central batching plant, where the sand was placed in an overhead hopper by a crane, was established. From this hopper the sand passed by gravity through shaker screens, then into a small mixer where cement was added and the batch dry-mixed. On being discharged from the mixer, the batch was raised by an elevator into another hopper from which it discharged by gravity into dump trucks which were backed under the hopper. The trucks then carried the mixed batch to the shotcrete machine and dumped it into a skip, with which it was elevated and dumped into a hopper over the shotcrete chamber.

The sand used in the shotcrete was river-run material delivered to the central batching plant by a contractor. After screening, it had a fineness modulus of 3.25. Water was obtained from the nearest ditch and carried to the site in a tank truck. Water was pumped to the nozzle from a 350-gallon water tank on the shotcrete trailer. Nine sacks of cement were used per cubic yard of shotcrete. A crew of six men handled the single-gun-size shotcrete equipment. The operation included water hauling and application of the curing compound on the finished lining, but did not include hauling the mixed material from the central plant. The nozzleman was paid $1.62½ per hour and the other five men were paid at various rates down to $1 per hour.

Following is a tabulation of the final costs for the job:

Materials (sand, cement, wire, curing compound)	per sq. yd.	$0.442
Mixing, hauling, placing wire, shotcrete and cure	do	.366
Subtotal	do	.808
Grading	do	.147
Total	do	.955

The material costs were:

Sand	per cu. yd. delivered	$1.45
Cement	per bbl	3.25
Wire	per square ($0.095 per sq. yd.)	1.06

The cost of placing the wire was $0.089 per square yard. (This includes the cost of delivering the wire to the job and of placing the 2-inch headers.) The total cost of the wire ($0.184) subtracted from the cost of the lining ($0.808) leaves a total unreinforced lining cost of $0.624 per square yard. A total of 78,000 square yards of lining was placed. These are field costs and do not include overhead or depreciation of district-owned equipment. (This cost ordinarily runs about 20 percent. At this rate, the cost, per square yard, of 1-inch paving would be $1.146, which is not unusual for lining of this type.—Ed.)

In addition to the use of pneumatically applied mortar for lining canals and laterals on the project, the district is utilizing its shotcrete equipment in the construction of canal structures. Some drop structures were built up with river rock and then faced with shotcrete. In other cases, checks were built up of concrete block and then faced with shotcrete. Slots for stop logs were formed in the concrete blocks, which were then laid in their proper positions.

In planning similar programs, other irrigation projects may profitably observe Maricopa County's shotcrete canal-lining experience. THE END

Inter-American Conference on Renewable Resources Held

The first Inter-American Conference on Conservation of Renewable Natural Resources was scheduled for September 7–20 in Denver, Colo. The conference was organized by the Pan American Union and the Department of State with the assistance of several other Government agencies, including the Department of the Interior. The conference is designed to discuss problems arising out of deforestation, flood, and increasing water supplies. Plans call for a study by the group of the Bureau of Reclamation's Colorado-Big Thompson project in relation to agriculture, grazing, and forestry practices on the land from which irrigation water is derived. A relief model of the project and other Reclamation exhibits will be included in the large display at convention headquarters.

Reclamation Engineers Going to Ceylon and Venezuela

In compliance with a Department of State request the Bureau of Reclamation is sending two of its engineers to serve as technical advisers on irrigation matters to the governments of Ceylon and Venezuela.

Mr. Paul von der Lippe, of the Denver office, is slated for at least a year's duty in Ceylon, while Mr. John L. Mutz, area planning engineer at Albuquerque, New Mex., is slated for 3 months' service in Venezuela.

News Round-Up

Lindsay-Strathmore Okays Central Valley Water Contract

By an overwhelming vote of 188 to 1 the Lindsay-Strathmore Irrigation District located in the San Joaquin Valley, midway between Fresno and Bakersfield, Calif., recently approved a water-service contract with the Bureau of Reclamation.

Under the contract, water delivery will be made in accordance with the 9 (e) clause of the Reclamation Act of 1939 for a period of 40 years. The rate will not exceed $3.50 per acre-foot for 18,000 to 30,000 acre-feet annually of class 1 (assured supply) water and $1.50 per acre-foot for class 2 water (indeterminate quantity, dependent on available supply and time of occurrence). The Bureau will also transport up to 12,000 acre-feet a year of water at present available to the District under established water rights from Wutchumna Ditch via the Friant-Kern Canal.

The water-service type contract differs from the older water rental contracts in that it provides for payment of annual water-service charges but does not require the water users to retire the construction cost of the water-supply facilities in 40 years.

United Western Investigations Move Along

Ground work for staffing the united western investigations is being laid by the Department of the Interior. This program, primarily a Reclamation activity, is designed to make preliminary explorations and studies of possible routes and means by which water from the Pacific Northwest can be diverted southward through interchanges to reach such southern points as San Diego and the Imperial Valley.

The investigation will coordinate planning work and draw on the investigative resources of the Bureau's Regions at Boise, Idaho, Sacramento, Calif., Boulder City, Nev., and Salt Lake City, Utah. Seven States are expected to benefit directly from the proposed diversion. They are Washington, Oregon, California, Idaho, Nevada, Utah, and Arizona. It is also expected that major indirect benefits will accrue to Colorado and Wyoming.

Department of the Interior Weed Control Committee Formed

More comprehensive studies are being made each year of losses and control costs caused by weed growth. An analysis of these studies has resulted in a greater realization by both the Government and the public of the vital need for creating more interest in weed control and for research to establish more economic methods of combating the weed menace.

Because of this realization a Department of the Interior Weed Control Committee has been formed in Washington, D. C., as a step toward gaining closer cooperation between

"KINK" IN THE RIVER

Engineers literally put a "kink" in the Colorado River when they diverted it at the Davis Dam site. This recent aerial photograph shows the mighty river flowing through its new man-made channel at the dam site following its recent diversion. (See "Detour at Davis" page 105, June 1948 Reclamation Era for a comparison between the above photo and MacGilchrist's drawing of the finished structure.) The lower end of the new channel was excavated through rock to a depth of 200 feet. The river originally flowed through the area at left which now has been pumped almost dry and soon will be excavated, in preparation for placing the earth and rock-fill embankment. The S-shaped structure in the center is the trestleway from which concrete is being placed into the power plant intake and spillway structures. Photo by Harry W. Myers, Region III.

the various agencies in the Department which are interested in weed control and to prevent duplication of activities.

The departmental agencies represented in the committee are: Office of Land Utilization, Fish and Wildlife Service, Office of Indian Affairs, Bureau of Land Management, National Park Service, and Bureau of Reclamation. The committee has chosen Agronomist Robert B. Balcom of the Bureau of Reclamation as its chairman. The committee plans to work closely with the Department of Agriculture's research program conducted by its Bureau of Plant Industry, Soils and Agricultural Engineering.

While it may be determined later that the committee may serve other purposes, some of the basic functions outlined during the first meeting held August 4 are:

1. To work toward making lands under the jurisdiction of the Department more useful to the public and prevent, insofar as possible, the spread of weeds to other lands.

2. To understand each agency's responsibilities and functions better, as well as its weed problems, so that coordination of weed work can be obtained rather than working separately and possibly against the interests of another agency.

3. To propose weed control problems needing further study.

4. To decide which agencies should undertake research in specific weed problems common to more than one agency to prevent duplication of work.

5. To find more economical and permanent solutions to weed problems through research conducted by Interior agencies or by or in cooperation with Agricultural or other agencies.

6. To exchange results of research and other findings concerning solutions to weed problems.

7. To propose and advise on legislation needed for advancement of weed control work in the United States.

8. To work with Weed Control Conferences, Council of State governments, and Federal, State, and local agencies interested in weed control.

Interior Officials Return from Paris Conference

Harvey F. McPhail, Director of the Branch of Power Utilization, and Wendall A. Morgan, head of the power system technical group, Denver, Colo., both of the Bureau of Reclamation, and Consulting Engineer Peter L. Bellaschi of the Bonneville Power Administration recently returned from the International Conference on Large Electric Systems held in Paris, France, the latter part of June and early July.

Mr. McPhail served as chairman of the American delegation which was sponsored by the State Department. In addition to the Interior Department representatives there were a number of other Americans from private corporations and Federal agencies interested in hydroelectric power. The purpose of the C. I. G. R. E., founded in 1921, is to provide for a free interchange of technical information between all countries engaged in power development. A comprehensive report on the conference is now being prepared by Mr. Morgan, a summary of which will be published in an early issue of the ERA.

Columbia Basin—Future Dairy Center

Dairy production on the Columbia Basin project has been estimated at 41,000,000 pounds of butterfat annually when the project is fully developed, says a report on the project issued by the Bureau of Reclamation of the Department of the Interior. If the entire commercial output were to go to cheese production, the project could support 38 cheese plants of 8,000 pounds per day capacity, or 75 cheese plants of 4,000 pounds per day capacity.

WOLF POINT

(Continued from page 186)

and the irrigation tractor and pumps toppled into the stream. Though discouraged, Mr. Appelgren sought to rectify this mistake by constructing a barge large enough to carry a tractor and irrigation pump. This was satisfactory until the river flow decreased rapidly, leaving one end of the barge on the river bank and submerging the other, again dropping the tractor and pump into the river.

Mr. Appelgren then determined to obtain the services of an irrigation specialist—Mr. G. H. Bingham, of Malta, Mont.—who suggested that the land be leveled and prepared for irrigation. With a number of teams and men, about 20 acres were leveled. The expense ran rather high so irrigation was started on a 20-acre scale. As it was found that the two 6-inch pumps were not adequate for the job, a 16-inch pump was obtained with a steam engine for power. However, costs enter into everything, and it was found that this was too expensive with hired help, even though coal and wood were available on the farm. The acreage was increased within a few years to 65 acres. Still considering the cost, a smaller pump with a 25-horsepower Diesel engine was obtained and used until World War II, when it was necessary to cease irrigation because of a lack of available labor.

Since then 70 acres more have been leveled with modern machinery, bringing the total to 150 acres. A new pump has been purchased that will supply 3 to 4 thousand gallons of water per minute.

Other farmers who started to irrigate about the same time as Mr. Appelgren, and are still irrigating, are Hans J. Hansen, Joe Pipal, Cusker Brothers, and James Twitchell.

The Bureau of Reclamation started its office in Wolf Point in April 1946 with Wallace H. Whiting as project engineer. Mr. Whiting rented office space, organized the survey crews, and conducted the work until January 1947. Then Harold W. Mutch was transferred from the Tucumcari project to act as project engineer, with Mr. Whiting as assistant.

Project planning has progressed, securing information which will provide a determination of feasibility of the various units in northeastern Montana. Preliminary location has been made of the proposed Missouri River Canal, the diversion dam from the Missouri River, and the proposed Big Muddy Dam site. The over-all plan, as generally outlined in Senate Document 191, Seventy-eighth Congress, second session, provides for a canal with a capacity of 6,200 second-feet, with water diverted from the Missouri River approximately 10 miles below Fort Peck Dam.

The canal would have a length of approximately 110 miles and would flow by gravity diversion to the proposed Medicine

NOTES FOR CONTRACTORS

Contracts Awarded During August 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2189	Missouri Basin, Wyo	Aug. 18	Two 8,333/10,417 kilovolt-ampere and four 3,333/4,444 kilovolt-ampere transformers for Boysen power plant.	Westinghouse Electric Corp., Denver, Colo	$130,492
2198	Fort Peck, Mont	Aug. 16	Four 2,500 kilovolt-ampere transformers for Miles City substation, schedule 1.	General Electric Co., Denver, Colo	71,055
2198	do	do	One regulating transformer for Miles City substation, schedule 2.	Moloney Electric Co., St. Louis, Mo	27,000
2198	do	do	Two circuit breakers and 3 disconnecting switches for Miles City substation, schedules 4 and 5.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	35,912
2198	do	do	Four lightning arresters and 3 current and 4 potential transformers for Miles City substation, schedules 7 and 8.	Westinghouse Electric Corp., Denver, Colo	11,870
2202	Hungry Horse, Mont	Aug. 18	Six 60,000 kilovolt-ampere transformers for Hungry Horse power plant.	Moloney Electric Co., St. Louis, Mo	765,982
2233	Columbia Basin, Wash	Aug. 3	Six radial-gate hoists for Main Canal headworks at South Coulee Dam.	United Engineering Co., San Francisco, Calif	40,530
2263	Klamath-Tule Lake, Oreg.-Calif	Aug. 30	Construction of earthwork and structures for Lost River diversion channel enlargement from Lost River to Klamath River.	George R. Stacy, Tulelake, Calif	549,144
2269	Riverton, Wyo	Aug. 31	Construction of earthwork, tunnel, and structures for Wyoming Canal; earthwork and structures for Muddy Ridge Canal; and laterals, sublaterals, and wasteways.	Morrison-Knudsen Co., Inc., Boise, Idaho	1,589,219
2271	Lewiston Orchards, Idaho	Aug. 12	Construction of one 15,000-gallon water storage tank for water treatment plant.	American Pipe & Construction Co., Portland, Oreg.	10,385
2278	Hungry Horse, Mont	Aug. 30	Four 13-foot 6-inch diameter penstocks for Hungry Horse dam and power plant, item 1.	Chicago Bridge & Iron Co., Chicago, Ill	699,200
2282	Fort Peck, Mont	Aug. 31	Construction of one 7,500 kilovolt-ampere substation at Wolf Point, Mont.	Elliott Construction Co., Omaha, Nebr	267,865
2285	Missouri Basin, Wyo	Aug. 6	Clearing Kortes reservoir site	Dawson and Corbett, Rawlins, Wyo	15,000
2296	Boise, Payette, Idaho	Aug. 13	Construction of earthwork and structures for Sand Hollow wasteway (East Branch) and Willow Creek wasteway.	Vernon Bros., Boise, Idaho	105,253
2307	Boulder Canyon-All-American Canal, Ariz.-Calif.-Nev.	Aug. 31	Construction of earthwork, pipe lines, and structures for lateral 97.1, and laterals 97.1-7.1W, 97.1-71NW, sublaterals, and wasteway, unit 5, Coachella Valley distribution system.	American Pipe & Construction Co., Los Angeles, Calif.	1,489,447
2322	Colorado-Big Thompson, Colo	do	3 steel expansion joints for intake pipes at Granby pumping plant.	Pacific Coast Engineering Co., Alameda, Calif	13,425
2326	Columbia Basin, Wash	Aug. 12	Galvanized steel towers and appurtenances for 230 kilovolt tie circuits, Grand Coulee power plant.	American Bridge Co., Denver, Colo	58,535
2333	do	Aug. 16	Fabricated structural steel for seat frame for floating caisson, Grand Coulee Dam.	George T. Gerhardt Co., Inc., San Francisco, Calif.	34,000
2341	do	Aug. 31	Miscellaneous structural steel for cable trays RC to R9, Grand Coulee power plant.	Vinnell Co., Inc., Alhambra, Calif	13,882
R1-20	Deschutes, Oreg	Aug. 2	Converting 4 barracks to apartment building at Madras Air Base.	R. P. Syverson, Bend, Oreg	34,453
D-6820	Central Valley, Calif	Aug. 5	Reinforcing steel	Bethlehem Pacific Coast Steel Corporation, San Francisco, Calif.	300,549

Construction and Supplies for Which Bids Will Be Requested by December 1948

Project	Description of work or material
Boulder Canyon, Ariz.-Nev	Governors for units A3 and A4, Hoover power plant.
Central Valley, Calif	Construction of earthwork, lining, and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Relocation of 7.2 miles of railroad spur above Keswick Reservoir between Middle Creek and Matheson, Calif.
Do	Painting 3 penstocks for Shasta power plant.
Do	230/196 kilovolt metering equipment for Shasta substation.
Do	3 bus reactors for Tracy switchyard.
Do	230/196-, 115-, and 69-kilovolt instrument transformers for Tracy switchyard.
Columbia Basin, Wash	Additions to 6,900-volt switchgear XLS, Grand Coulee power plant.
Do	Construction of North Dam, an earth-fill structure which is to form the north barrier of Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for 15.3 miles of West Canal near Ephrata, Wash.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Davis Dam, Ariz.-Nev	13.8-kilovolt bus structure for Prescott substation.
Do	Main control board for Prescott substation.
Do	Structural steel for Davis power plant.
Do	Metal doors for Davis power plant.
Fort Peck, Mont	Construction of about 4.3 miles of 12.5-kilovolt wood-pole transmission line near Savage, Mont.
Do	Construction of 500-kilovolt-ampere substation which is to furnish power supply to the Savage pumping plant.
Gila-Wellton-Mohawk, Ariz	Pumping units for pumping plants 1, 2, and 3.
Klamath, Calif.-Oreg	Improvements of Lost River channel in Langell Valley near Klamath Falls, Oreg.
Lewiston Orchards, Idaho	Construction of filter plant and Clearwater Reservoir which is to supply water to domestic and irrigation distribution systems near Lewiston, Idaho.
Minidoka, Oreg	Concrete canal lining at mile 2 in Milner-Gooding Canal near Burley, Idaho.
Mirage Flats, Nebr	Removal of portion of existing Cottonwood Creek siphon and lengthening of siphon near Hemingford, Nebr.
Missouri Basin, Kans	High-pressure gates for Cedar Bluff Dam.
Missouri Basin, Nebr	Furnishing and erecting 20 prefabricated residences for government camp at Superior, Nebr.
Do	Construction of Superior-Courtland Diversion Dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior, Nebr.
Do	Construction of earthwork and structures for about 6.5 miles of Cambridge Canal near Oxford, Nebr.
Missouri Basin, N. Dak	Construction of 1,500-kva. Watford City substation, North Dakota.
Missouri Basin, Wyo	Construction of about 1.5 miles of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Ogden River, Utah	Construction of earthwork and structures for an equalizing reservoir for south Ogden lateral distribution system.
Do	Installation of Venturi meter in a 75-inch pipe line of the Ogden Canyon conduit.
Riverton, Wyo	Construction of concrete structures for Lost Wells and Pilot laterals, near Riverton, Wyo.

Lake Reservoir. From Medicine Lake Reservoir the water would be pumped over into North Dakota and utilized to irrigate approximately 1,400,000 acres of the Missouri-Souris unit in North Dakota.

The unit will also include construction of 16 pumping units along the south side of the Missouri River in Montana, with a total area of approximately 36,000 acres. Under the main canal, on the north side of the Missouri River in Montana, about 48,000 acres of land will be irrigated by gravity. These lands lie between the canal and the river and extend from the diversion dam to Medicine Lake Reservoir. An additional 52,000 acres of land will be irrigated by pumping from the main canal, and about 67,000 acres by pumping directly from Medicine Lake.

Sufficient moisture, heavy yields and good prices of the last few years have brought hope and a minor degree of wealth to most of the farmers, but they have not forgotten those drought years from 1931 to 1940, low prices and "Black Blizzards." Many are anxiously awaiting development and completion of the Missouri-Souris unit that will so greatly benefit them and insure, through irrigation, greater economic stability.

THE END

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U. S. Docs.

Reclamation ERA

OVEMBER
1948

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Kansas City, Mo

Field of irrigated lettuce in the Salt River Valley, Arizona
Bureau of Reclamation photo by Ben D. Glaha

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J. A. Krug, Secretary

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REGION VII—Avery A. Batson, Regional Director, 318 New Custom house, Denver, Colo.

Letters to the Editor

Part of the Job

Earl W. Larsen, 337 South Albion Avenue, Burley, Idaho, with his remittance for a renewal to the Reclamation Era wrote:

I enjoy every copy, get a great deal of helpful information for my part of the job as Watermaster.

(Continued on p. 201)

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Ruth F. Sadler, *Editor*

Corrections

In "Gila Homesteaders Take Over," September 1948 issue, tenth line from the top of page 174, a typographical error was made in the amount of predevelopment payments to be made by the homesteaders after the first 10 years. The figure should have been $3.50 instead of $2.50 per acre.

The two excellent photographs on page 176 of the September 1948 issue, illustrating the article "Irrigation and Drainage of the Willamette Valley" were furnished the Era through the courtesy of Mr. John Burtner, Extension Editor, Oregon State College, Corvallis, Oregon. It is regretted this credit was omitted.

LETTERS (Continued)

Thanks to the Reclamation Era

ROUTE 1, BOX 923, ASTORIA, OREG.,
September 9, 1948.

DEAR EDITOR: I noticed in the July issue that the Northern Pacific Railway had about 30 farm units in the Pasco pumping unit to sell. I wrote in and fortunately qualified and purchased one of these units. Thanks to the RECLAMATION ERA.

Truly yours,

CHESTER C. DIXON.

Irrigation District Members Included

HIGHLEY, ARIZ.
July 7, 1948.

DEAR EDITOR: Certainly your publication is most enlightening and helpful to me and I would not want to be without it. However, please note that I own land in an irrigation district, which I am not certain entitles me to the lower rate for subscription.

Enclosed I send you my personal check in the amount of 1 dollar. Does it entitle me to 1- or 2-year subscription?

HOWARD MARTINDALE,
Roosevelt Water Conservancy District.

¶ To reader Martindale, thanks for the kind words; and for him and other members of irrigation districts in the West the ERA is only 50 cents a year—Ed.

Associated General Contractors' Attitude

Via the former Chief Engineer's office we received the following communication from the Associated General Contractors' George H. Atkinson. We are printing this letter and Walker R. Young's reply as an acknowledgment and notification to contributors. Those connected with the publication of material appearing in the RECLAMATION ERA have already noted this comment.

GUY F. ATKINSON CO.,
CONTRACTORS AND ENGINEERS,
10 WEST ORANGE AVENUE,
SAN FRANCISCO, CALIF.,
April 15, 1948.

DEAR MR. YOUNG: As a member of the Associated General Contractors Contact Committee, an article in the December 1947 issue of the RECLAMATION ERA written by Mr. William T. Easterday and titled "The Drama of a Big Bid Opening" has been called to our attention. One paragraph therein reads as follows:

The Government announces a date and place for opening of bids. At a certain hour, usually 10 a. m., all bids must have been submitted in sealed envelopes and the opening proceeds. Often the bids are received at the very last minute, since the firms' representatives gather together before the opening and try to find out what the others are bidding, scaling their own bids down to a minimum just before the deadline.

We are quite certain that Mr. Easterday intended no harm in writing this paragraph, but our members have taken exception to the inference made by the last sentence therein that representatives of the various competitive firms in any way compared bids before a letting. We are certain that no responsible contractor permits his representatives to in any way discuss a bid before it is opened, and believe that it is unfortunate that such an impression is gained on a first reading of this article. We are fully aware that many machinery salesmen and others do considerable "gossiping" before a letting, but know it is not customary for representatives of the contracting firms to join in any such discussions.

Since we feel that it is a matter of mutual concern to both your organization and to ours that no shadow be cast on the integrity of competitive bid openings, we are simply writing you to call this matter to your attention. We feel that it was undoubtedly unintentional and should be dropped in this instance. However, we suggest that you bring the matter to the attention of the editor so that future statements of this type may be avoided unless some specific case is cited.

With all best wishes,

Yours very truly,

GEO. H. ATKINSON.

APRIL 23, 1948.

DEAR MR. ATKINSON:

I appreciate your informing me on the attitude of the A. G. C. members toward a paragraph of the article entitled, "The Drama of a Big Bid Opening," which appeared in the December 1947 issue of the RECLAMATION ERA. I am particularly concerned about preserving the integrity of our competitive bidding practices, and I am sure that Commissioner Straus shares my concern. To advise him of the reception of the ERA article by members of the A. G. C. I am taking the liberty of forwarding the Commissioner a copy of your letter of April 15, 1948. I am certain that he will be glad to see that such statements as you refer to are avoided in the future.

Sincerely yours,

WALKER R. YOUNG,
Chief Engineer.

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to begin thinking of your Christmas shopping.

Solve your gift problems by sending subscriptions to the RECLAMATION ERA to your friends. Each month they will be reminded of your thoughtfulness, and if you send your subscription in time, we shall mail a special Christmas Subscription Certificate to notify them of your gift. Simply fill in the blank below with the name of the person to whom the subscription is going, and add "Christmas Gift Subscription from _____" with your name clearly printed so that it may be inscribed on the certificate. Attach the names and addresses of additional persons to whom you wish to send the ERA as a gift to the blank with your remittance.

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(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

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(Name and address of association)

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OKLAHOMA—Region of Opportunity

Oklahoma—last of the States formed from the Louisiana Purchase—brought into the Union a wealth of natural resources: timbered mountains, treeless plains, fertile soils, valuable minerals and building materials, and rich reserves of petroleum. These resources attracted a restless, energetic people. When statehood was proclaimed November 16, 1907, and the union of Oklahoma Territory with the unorganized Indian Territory was consummated as the forty-sixth State, 1½ million new citizens were added to the Union—a population greater than any of 20 States and four times as many as in any other State at its time of admission.

Oklahoma, though a young State, has encompassed much history within its borders. During most of the last century this region was Indian country, a dragnet that caught remnants of almost 50 tribes thrust from their native habitat by white expansion.

Here they found temporary respite from eventual absorption as land-hungry whites below, above, and beyond their land established territorial or State governments. Settled among the hills and valleys along the rivers and creeks of eastern Oklahoma were the Five Civilized Tribes, the Cherokee, Creek, Choctaw, Chickasaw, and Seminole Indians, dispossessed of their native lands in the Southern States, reluctantly lured by the shibboleth that this new country should be theirs "as long as the grass grows and the waters run."

These tribes included members and mixed-bloods who had been men of influence and substance in their former homes. Some owned slaves; many of these were skilled artisans. Building upon what they had salvaged from the removal, aggressive leaders fostered commerce and industry in the new land, established republican forms of tribal government and, midst the turmoil of mutually destructive jealousy, progressively advanced in adopting the white man's culture.

Because the Five Tribes sympathized with the Confederacy, the Federal Government forced concessions that brought about a great transformation in Oklahoma. The Five Tribes had to surrender most of their western lands: remnants of Indian Tribes were settled on reservations and once powerful nomads who had followed the buffalo were forced to an adjustment of livelihood and beggarly assistance that led to the allotment of lands and usually, to individual destitution.

The great range cattle industry flourished. Welsh and English emigrants were brought in to work the rich veins of coal owned by the Choctaws and Chickasaws. Railroads

Immediate left: An ancient and youthful member of the Kiowa tribe meet. They are only two of more than 100,000 Indians in Oklahoma, thousands of whom meet with Indians from all over the U. S. at Anadarko, Okla., to relive customs of the past. Bottom left: Pioneer Woman Memorial statue at Ponca City, Okla. Bottom right: A street scene in Oklahoma City, soon after Opening Day, April 22, 1889.

were constructed that speeded up the attraction of this rich, lovely land.

On April 22, 1889, the Federal Government opened the unassigned lands, a heart-shaped region of almost 2 million acres within the center of the State, to settlement. Five openings followed in the western half of the State while, meantime, the final dissolution of tribal sovereignty was taking place among the Five Tribes. After halting individual attempts by the two regions to enter the Union as separate States, single statehood was achieved November 16, 1907.

At this time Oklahoma's economy was predominately agricultural; urban population amounted to only 7.4 percent in 1900. Although the State has almost doubled in population—at statehood, 1,414,177 and in 1940, 2,336,434—a preponderant shift has been made away from the farms to the cities. Now, more than 60 percent of the State's labor force is employed in nonagricultural pursuits.

But agriculture remains the principal source of income. With nearly 35,000,000 acres of its total area of some 44,000,000 acres in farms, Oklahoma produces every major crop grown in the United States. Varied soils, contrasting topography and a spread in average annual rainfall—20 inches in the northwest to more than 45 inches in the southwest—have made possible great diversity in agricultural methods and products. Wheat, cotton, corn, oats, peanuts, alfalfa and alfalfa seed, broomcorn, pecans, watermelons, and other agricultural products returned producers last year $473,328,000. Livestock, dairy products, poultry and eggs brought this total to $742,253,000.

Indicative of the interest in improving agricultural practices, the State is blanketed by soil conservancy districts and is pushing this program to build and conserve its soil resources. And destined to continue agricultural advancement are members of the Future Farmers of America and 4–H Club organizations. These boys and girls have won more national awards in their project work during the past 20 years than those of any other State.

Present enrollment in 4–H Club work is 64,666; the State boasts a 4–H Club alumni of more than 800,000, many of whom are now successfully practicing their early lessons on farm improvement. There are 191 Future Farmer Chapters in Oklahoma with a membership of approximately 10,000. A proposal to double the youth farm program has the active support of Governor Roy J. Turner and other agricultural leaders. Such men, too, have sponsored the up-breeding of livestock by the youth organization; this year Oklahoma had 12 4–H Club winners in national achievement contests at Chicago, while a steer owned by Claude Millwee, a Future Farmer lad from Fort Cobb, won the grand championship at the International Livestock show.

The petroleum industry, long prominent in Oklahoma's economic life, has been a compelling force in industrial advance. Since the drilling of the first commercial producing well at Bartlesville, Cherokee Nation, in 1897, approximately 5,750 million barrels of oil valued at $7,700,000,000 have flowed from Oklahoma wells. Estimated additional reserves of 1 billion barrels remain underground. Daily crude oil production exceeds 400,000 barrels. Some of the older fields produce from six separate horizons while exploratory efforts open new fields or extend the boundaries of old fields

A mixture of oil and corn. Farm crops growing within the shadows of oil rigs are not uncommon sights in Oklahoma.

each year. Oklahoma since statehood has never ranked below fourth among the States in the production of oil.

This led to the heavy concentration of oil refining in the State. There are now 25 active refineries with a daily capacity of 226,000 barrels of crude oil which produce innumerable byproducts. These plants in 1939 employed 5,133 workers who received $8,578,455 in wages for manufacturing products worth $106,666,837. The value added by manufacturing amounted to $18,085,209.

It would be difficult to estimate the influence the oil industry has had upon the State's development. Land-owners in every county have benefitted from leasing operations; there is probably no town in the State where none of the citizens have made money, lost money, or invested in this highly speculative enterprise. Lawyers, royalty-owners, lease-brokers, county and State governmental units benefit from the industry while hundreds of families are directly dependent upon the industry for employment in exploratory, drilling, pipeline, refining, wholesale, and retail operations. The manufacturing and handling of oil field supplies, too, is a leading industry.

Oklahoma has enough other minerals to give it fifth place among all States as a producer of mineral wealth. It has a coal reserve of some 55 billion tons, 125 billion tons of gypsum, and billions of tons of dolomite, limestone, volcanic ash, rock wool, rock asphalt and a host of other minerals. Leader in lead and zinc production, noted for its building

stone and glass sand, Oklahoma is just beginning to realize the importance to industry of other minerals.

Probably of greatest recent significance industrially to Oklahoma has been the concentration of the glass industry in the State. Thirteen glass companies now operate plants near cheap, abundant fuel and one of the greatest supplies of glass sand in the Nation. This industry is growing and it has been prophesied its payroll in the State will soon rival that of petroleum refining, Oklahoma's greatest industry.

Food processing, wheat milling, and the manufacture of dairy products are tending to balance the State's agricultural production and processing economies while, in the southeastern part of the State, extensive timber resources are being used for the manufacture of timber products. From 1940–1944 manufacturing payrolls increased Nation-wide only 39 percent while in Oklahoma they increased 80 percent, largely because of the concentration of war industries in the Southwest. Recent estimates indicate that Oklahoma's advance in manufacturing during the postwar period ranks sixth among the 13 Southern States. There was five times more private construction of business houses, warehouses and factory sites last year than in 1939.

Legislation enacted last year made the tax structure more favorable to industry. Oklahoma makes no State-wide ad valorem levy; the State income tax was reduced one-third. Products sold for use outside the State are exempt from sales tax; machinery and equipment are exempt from sales and use tax. A new business corporation code with advantages incorporated in the liberal Delaware Code was adopted.

Factors, too, in the recent industrial expansion in Oklahoma are natural gas and electric power. Oklahoma has adequate supplies of natural gas to meet demands made by industrial expansion. The estimated reserves of 10,735 billion cubic feet assure heavier use of this important fuel within the State.

Approximately 12 percent of the electric power supply is owned by municipalities, 12 percent is under State or Federal agencies, and the remaining 76 percent is privately owned. Great generating plants have contributed toward increasing power output ten fold since 1920. Oklahoma exported electric power during the war and is capable of furnishing power to much more industry than is now within the State.

Oklahoma is the home of the W. C. Austin reclamation project, now nearing completion by the Bureau of Reclamation. This 45,000-acre project at Altus is further east than any previously constructed by the Bureau. As pointed out by Former Governor Robert S. Kerr of Oklahoma in his article, "Plow, Plant, and Pray" (see RECLAMATION ERA, May 1948), Oklahomans are optimistic about the future of reclamation in their State. There are 2,810,000 acres of fertile, alluvial lands in the flood plains of Oklahoma's streams. Oklahoma has an additional 1,300,000 acres of second bottom lands. The bottom lands are all classified as superior soils. Reclamation appears to be the most promising new frontier in the State. Under direction of a vigorous State Planning and Resources Board, Oklahomans are moving ahead toward reclamation and the next decade is expected to witness a halt in much of the water that has been moving unused to the Gulf since '89 and before.

Prompted by the war impetus, gifted with natural resources, aided by State legislation, Oklahoma is rapidly working out a more equitable balance between agriculture and industry—building, progressing, growing. THE END.

National Reclamation Association Convenes November 17

Oklahoma City, Okla., will be the site for the Seventeenth Annual Convention of the National Reclamation Association on November 17, 18, and 19, 1948.

In its official call to members, the National Reclamation Association outlined the objectives of the convention in these words, "To speed the completion of projects under way . . . to attain better economic conditions through reclamation development . . . to integrate the plans and actions of the Association with those of the States and of the public which it serves . . . and to coordinate those plans and actions with the agencies by which the work is done . . ."

Wednesday, the opening day session, will feature reports of committees and officers of the Association. State caucuses will be held to select State directors, members of the resolution committee and a State caucus secretary.

Thursday's session will be a Water Users' Day which will be devoted exclusively to the activities and problems of water users. Several irrigation farmers will participate in the program. There will be a discussion of Sprinkler Irrigation, followed by an actual field demonstration.

Topics of interest to irrigation water users will be scheduled as a series of round table discussions, featuring problems relating to irrigation, operation and maintenance, repayment contracts, legislation, relationships with the Bureau of Reclamation and other pertinent subjects.

The Friday session will be devoted to reports and papers by Commissioner Michael W. Straus of the Bureau of Reclamation, Department of the Interior; Lt. Gen. R. A. Wheeler, Chief of Engineers, Department of the Army; and J. C. Dykes, Assistant Chief, Soil Conservation Service, Department of Agriculture. President of the Association of Western State Engineers O. C. Williams will discuss "Ground Water Problems of the 17 Western States," and Fred E. Buck, Montana State Engineer, will discuss "State Responsibility for Small Project Development."

In a special message to all members of the National Reclamation Association and friends of resource development, Gov. Roy J. Turner of Oklahoma said, "The development and improvement of programs involving water conservation, irrigation flood control, hydroelectric power, municipal and industrial water, and recreational facilities are vital to a strong and productive national economy."

The Board of Directors of the Lugert-Altus Irrigation District, and the Board of Directors of the Altus Chamber of Commerce issued a special invitation to delegates and visitors to view Oklahoma's first Federal Reclamation project on Saturday, November 20, (see page 209) and become ac-

(Continued on page 220)

The "New Look" in Thanksgiving Turkeys

by PHIL MERRITT, Photographer, Region 1, Boise, Idaho
(Photographs by the author)

"YOU DON'T NEED COLORED MARBLES."

This phrase means very little to the average person, or at best it only recalls some incident years ago when he was playing for keeps and lost his choice "aggie." But to Mr. and Mrs. George Kratzberg of Notus, Idaho, it means a livelihood.

They raise turkeys, white ones to be exact. This particular breed is distinctly different from the ordinary bird. From the day the white poult is hatched it is a good eater and the Kratzbergs do not have to resort to the old system of putting colored marbles in the mash, which is used by some turkey raisers to attract poults to the feed rack. Since the success of raising turkeys depends upon the rapid rate in which they mature, "You don't need colored marbles" is an all important axiom on the Kratzberg ranch.

The Kratzbergs live on a 54-acre irrigated farm near Notus, on the Boise Federal Reclamation project. They are relatively new in the turkey business but are not without experience at farming. For many years they farmed on a share basis near Melba, Idaho. This experience taught them one thing—if you have a place of your own, the one way to make a better living is by raising the best stock, be it poultry or crop.

In 1947, 4 years after having purchased their present farm, they started raising the Beltsville turkeys, named after the Beltsville, Md., experiment station of the Department of Agriculture where they were developed. Their irrigated farm was an ideal location to try the new breed. They had good pasture land available for a turkey range and were producing alfalfa as an important green feed. The climate also was well suited for the projected enterprise. The location, available feed, maturity rate, and demand, all seemed to predict a successful venture which it has turned out to be.

From eggs laid by 40 hens during the summer of 1947 they hatched 1,996 poults for the following fall. This represented 83 percent fertility on all eggs hatched—an exceedingly high figure, and an encouraging start for the Kratzbergs.

The Beltsville turkey is different from ordinary turkeys in appearance and manners. It is all-white-feathered with a dark blue head and red wattles. The bird was developed by crossing White Holland, Black Narragansett, White Austrian, Bronze, and wild turkeys. The turkey is broad-breasted and carries more meat per pound of bird. It has a firm thick breast of white meat which cooks in a shorter length of time and retains more moisture and flavor. When mature the hens weigh from 8 to 10 pounds and the toms from 12 to 18 pounds. This lighter-weight bird fits the average family table and budget perfectly.

Too pretty to eat. Young Wallace Frank holds a typical white Beltsville turkey, product of the Boise, Idaho, Reclamation project. These birds are said to provide more meat than the ordinary variety, and are especially bred for small families.

The poults are started in electric brooders and fed mash for about 10 days, followed by a combination of mash and wheat. After graduating from this infant stage they thrive on mixed grain with wheat. In 8 weeks the poults are ready to take to the field, weather permitting. Within 6 months the turkeys are ready for market. During this relatively short time the turkeys have consumed less feed than their bronze relatives and will demand 5 to 7 cents more per pound when sold. Hatching occurs from April to August and marketing from October to February.

Last year the Kratzbergs retained 240 hens for the 1948 hatching season, the increased population requiring three brooder houses and three temporary tents for shelter. They have a standing order with the Beltsville farm for eggs and their stock is renewed yearly.

The birds are good year-around layers. Eggs are gathered four times a day. Because of their value, they are collected regularly and carefully. Once a week George takes the crates of eggs from his special cellar to the hatchery. Next year he hopes to have incubator batteries of his own.

During the winter months the flock stays inside on elevated pens and screened-in sun porches which aid the birds in living a clean and healthy life. A slat flooring on the porches simplifies cleaning operations. A wheelbarrow can

There are two birds in that hand. "Handle with care" is the slogan when Kratzberg collects turkey eggs four times daily. Value? $1.00 each.

"You don't have to use colored marbles" to get these birds to eat. This easy method eliminates footwork ordinarily required to get turkeys in and out of coop.

be run under the porches where the droppings collect. This valuable fertilizer is utilized on the farm, as all good farmers do.

George says that he does the work while Mrs. Kratzberg keeps the books and answers the correspondence, but he always has a big smile for the Mrs. when he says it. Their daily mail is an amazing assortment of orders and inquiries. Often Mrs. Kratzberg has 30 or more cards to write to answer the overwhelming assortment of orders, which amount to many times the number of eggs or poults for sale. Requests for 500 to 1,500 poults are common and, regretfully, they must be rejected, for the turkey farm is but a young 2-year-old enterprise and with the thoroughness required in raising turkeys successfully, large-scale production cannot be achieved overnight.

The Kratzbergs have two silent partners working full time on the farm, Bonnie and Laddie, two pure-bred Scottish border working collies. The dogs are natural herders. When the turkeys run loose on the alfalfa range and through the 5 acres of sunflowers planted for them the two dogs keep the birds in check. No fence is required to keep strays from running wild. The dogs work in a deliberate, slow, creeping manner, nosing the birds along in a flock. They never bark, bite or run when working turkeys. The dogs seem resentful that the Kratzbergs' chickens are fenced for they indicate that they would like to assume the additional responsibility. However, this spring Bonnie had a family of her own and she was more than busy trying to keep an eye on the turkeys in the pens and yet give her family the necessary attention.

The success that a person achieves is often measured by the enthusiasm he displays for his work, and this is no exception on the Kratzberg farm. Mr. and Mrs. Kratzberg have built their business on their own initiative. Long hours, patience and experience have taught them the right way to do things. All of their energy is directed towards bettering the production of turkeys. No detail is too small to be overlooked. If you visit the farm and express a desire to look at the birds, Mrs. Kratzberg will probably ask you, "Are your shoes clean?" or "Have you been in any other poultry house today?"

Early this spring they had already sold 5,000 poults for the coming season, and shipped 400 eggs to Iowa and 800 to Canada. In addition they filled a multitude of local orders for turkeys. Every day looks like a visitor's day at the Kratzbergs. There is a good demand the year around for the table birds. Next year, if all works out well, the Kratzbergs will have their own dressing plant, where the turkeys will be dressed and quick frozen for sale on the farm.

Even though the turkey business is a full-time job, the Kratzbergs have other duties to perform. They have 20 sheep, 12 Jersey cows, 20 Spotted Poland China hogs, 250 to 300 chickens and a few horses.

But the way the business is growing, some day the other animals will have to give way to the white-feathered bird which is the "King of the Kratzberg Farm" and the "Pride of The Boise Valley." THE END.

New Electrical Power Developments in Europe

by WENDAL A. MORGAN, Head, Power System Technical Group, Branch of Design and Construction, Denver Colorado

Early last summer Harvey F. McPhail, Director of the Branch of Power Utilization, and I attended the International Conference on Large Electric High-Tension Systems held in Paris. The organization, known familiarly as C. I. G. R. E. (Conférence, Internationale des Grands Réseaux Électriques á Haute Tension), was established in 1921, as a permanent international organization to promote the exchange of engineering information on technical matters related to the design, construction, and operation of large high-voltage electric power systems.

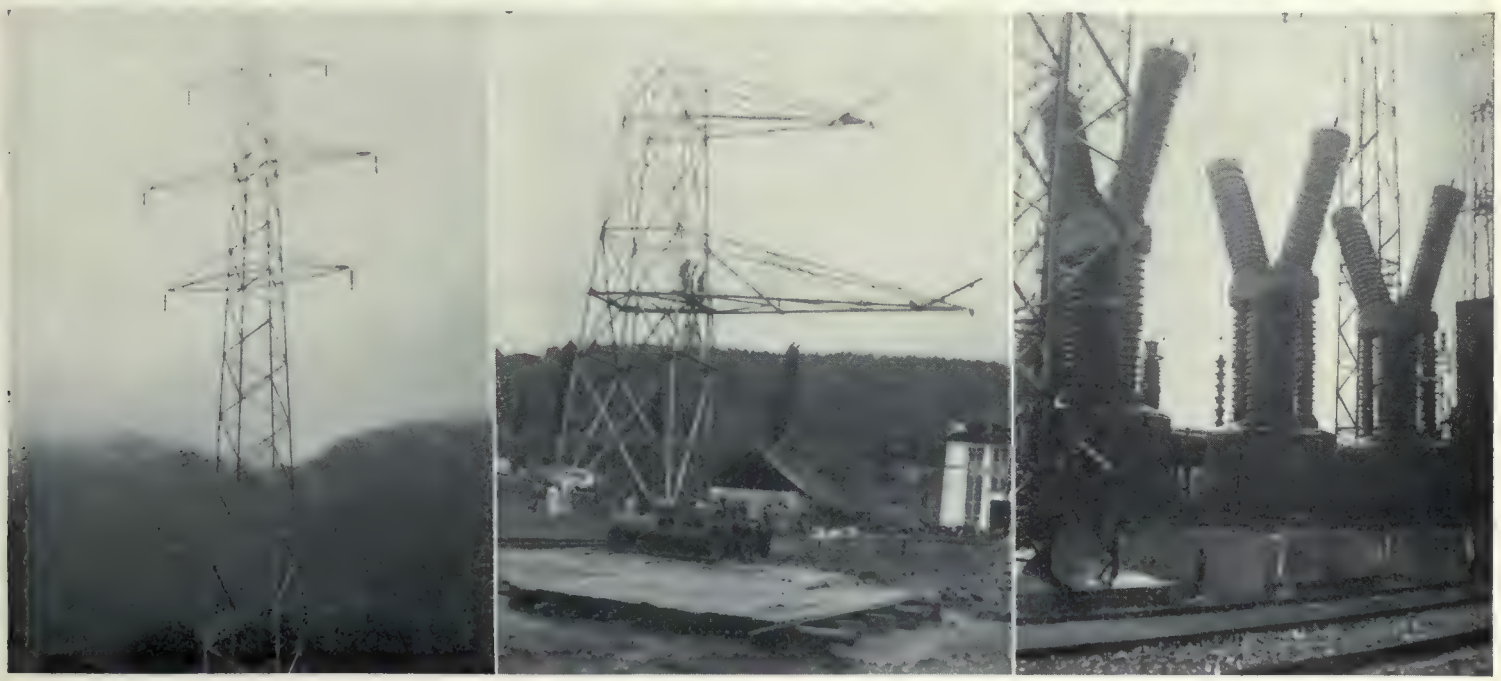
In attendance at the conference were 1,140 engineers from 40 countries including 15 engineers from the United States. Mr. McPhail acted as Chairman of the United States delegation of State Department representatives, and I presented two papers, served on an international study committee on power-system stability, and presided before one of the general meetings in the absence of Mr. L. N. McClellan, Chief Engineer of the Bureau, who was unable to attend the conference.

Over 100 technical papers, including 13 by United States authors, were presented at the conference, most of which were discussed at considerable length at conference meetings. The official languages were English and French, and the discussions were translated by an interpreter.

Foreign engineers at the conference exhibited great interest in technical advancements made in the United States and were most generous in supplying information on new developments in the countries which they represented. It is my conclusion from the conference that the United States is advanced technically in many fields of electrical engineering as compared to other countries, but in the field of high-voltage transmission, European engineering is ahead of that of the United States. This is probably due to the recognition in Europe of the necessity for concentrating on hydroelectric power development as a means of conserving coal and other fuel resources. Since hydroelectric power installations are usually widely separated from load centers, considerable pioneering and research in the development of long, high-voltage transmission lines have been required in European countries.

Inspection trips and discussions with European engineers after the meetings were as important as the conference itself in acquiring knowledge of hydroelectric power development practices. At part of the C. I. G. R. E. Conference, inspection trips were made to major power stations in Paris and to the new Genissiat Power Plant on the Rhone River in the French Alps. It was interesting to note that the French have had 230-kilovolt underground cable in use for 15 years and are using it quite freely, whereas 132-kilovolt is the highest voltage cable installed in United States. A visit was also made to the large hydraulic laboratory and equipment manufacturing plant of Negret Beglier and Piccard Pictet at Grenoble, France. The hydraulic laboratory is claimed to be one of the largest of its kind in the world and has models of ocean harbors, rivers, dams, and irrigation structures for Africa, Australia, Spain, and other countries. It was of particular interest because of the similarity to the Bureau of Reclamation laboratories in Denver.

At left: 380-kv double circuit transmission line under construction in Switzerland. Towers of thin steel tubing members filled with concrete are 173 feet high. Conductor spacing is about 29 feet. Below center: full scale model tower for unbalanced force tests of new type concrete-filled, steel-tube construction in Switzerland. The tower withstood about 17 tons, equivalent to 2½ times the unbalanced pull of two unbroken conductors. Below right: low oil content circuit-breakers for 230-kv, 2.5 million-kva interrupting capacity services in France. The contacts are in the upper branches of the "Y."



Through contacts made at the conference, I arranged a trip to Switzerland to witness tests of a concrete filled, steel tube constructed transmission line tower and to inspect some unusual hydroelectric power plants. Swiss engineers of the Motor-Columbus Co. developed this new type of tower which uses considerably less steel than the conventional steel angle tower. The concrete increases the buckling strength of the thin tubes by taking the compression stresses. In Switzerland, where labor costs are low and steel tubing costs approximately twice as much as steel angles per pound, the towers cost about 35 percent less than the steel angle towers, an over-all savings of about 17 percent in transmission line costs. This new type tower is used on the double-circuit, 380-kilovolt line now under construction and also on 50- and 150-kilovolt lines, which I observed in operation.

The Chandoline Power Plant in the Rhone Valley in Switzerland, with a static hydraulic head of 5,740 feet is the highest head plant in the world. A hollow gravity-type dam creates a forebay reservoir at the base of three large glaciers, and a tail-race canal feeds directly into the Rhone River. Each of the five 37,500-kilovolt ampere generators has two 21,250-horsepower Pelton wheel turbines supplied from the two penstocks, so that the plant may be operated at half capacity when one of the penstocks is removed from service for maintenance. This plant has many features not found in American plants because of our practice of stressing economy of design.

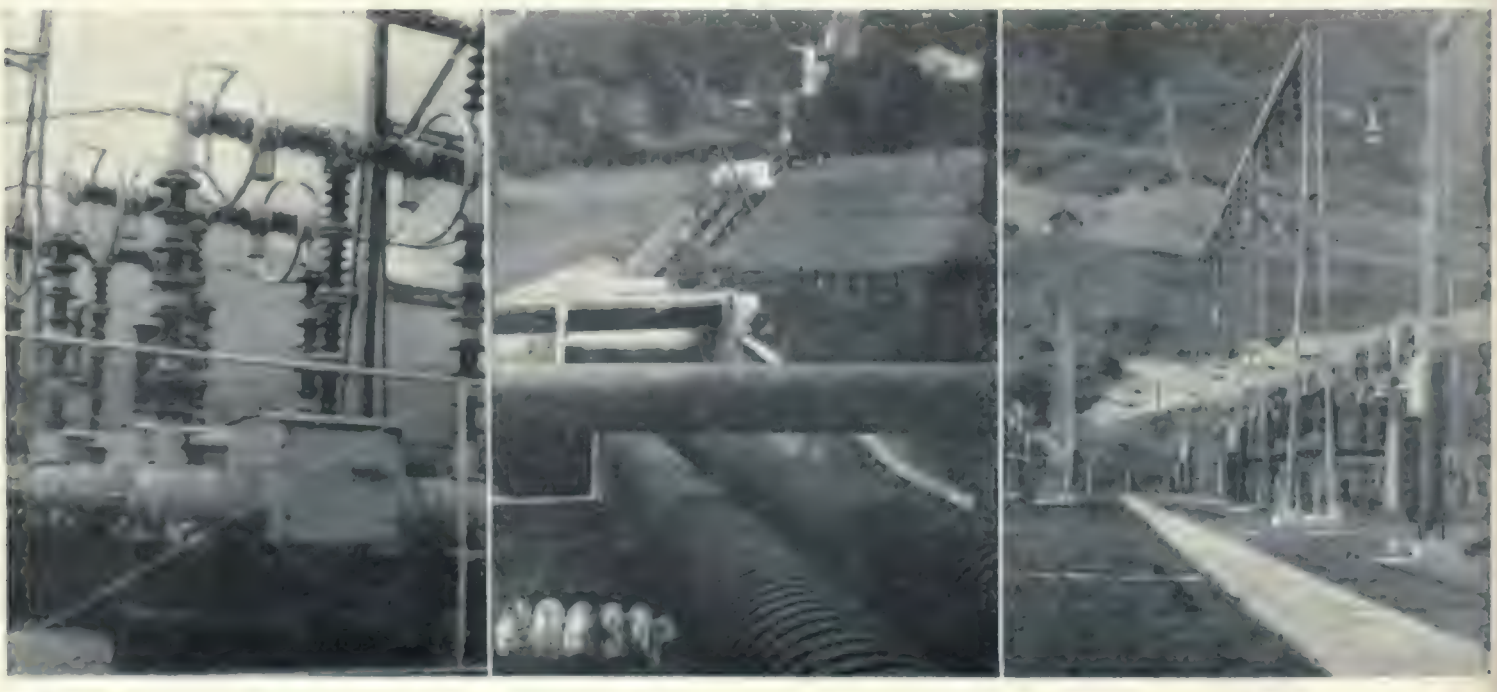
While in Switzerland, I inspected an underground power plant of 250,000-kilowatt capacity and observed two others under construction. Many such underground power plants are being built in Europe. Swedish engineers claim it is less expensive to excavate rock for a power plant than it is to construct an outdoor building. This is particularly true of a plant where a penstock can be brought down through a tunnel and where the surrounding canyon walls are steep. This plan of construction is considered good engineering practice as well as providing better protection from bombing.

Considerable interest at the conference was manifested in extra-high voltage, alternating-current, power transmission over long distances. Sweden is building hydroelectric power plants which are about 600 miles from the load centers and which will be connected to the present 230-kilovolt transmission system by a 380-kilovolt transmission line. The 380-kilovolt system will go into operation in 1951. France has already constructed a 250-mile, 400-kilovolt line, although it is now in operation as a double-circuit 230-kilovolt line. French engineers anticipate the six conductors in this initial double-circuit 230-kilovolt line will later be rearranged to operate as a duplex conductor, single-circuit 400-kilovolt transmission line. Switzerland is constructing a double-circuit 380-kilovolt line, but it, too, will be initially operated at a lower voltage. Eventually continental European systems will be interconnected at 380 or 400 kilovolts. England is constructing lines for future operation at 275 kilovolts which is about twice the voltage of their present 132-kilovolt grid. The highest voltage transmission lines in the United States are the 287-kilovolt Hoover Power Plant to Los Angeles lines, and, although experiments are being conducted on voltages up to 500 kilovolts, no higher voltage lines than those now in operation are known to be in immediate prospect.

Extra-high voltage transmission introduces a problem of corona and radio interference. Experiments show this can be overcome by a single large diameter conductor or by two smaller conductors spaced about 18 inches apart. Indications are that the duplex conductor scheme is favored by most engineers because it has only 80 percent of the reactance of a single conductor and, therefore, will increase the

(*Continued on page 218*)

At left: European air circuit-breaker of new design for 150-kv service with interrupting time of 0.04 to 0.05 second and reclosing time of 0.20 second. Contacts are in horizontal part of "T" and air under high pressure comes up through center column and blows out the arc. Center: two penstocks of Chandoline Power Plant in Switzerland are reinforced with steel hoops over 1½ inches thick to take care of high pressures resulting from hydraulic head of over one mile. Penstocks decrease in size as pressure increases, from 4.65 feet diameter, 0.40-inch thick smooth pipe, to the 3.23 diameter, 3.11-inch thick, hoop reinforced pipe shown in the picture. At right: switchyard at Lucendro Power Plant in Switzerland, with penstock in background.



Visit the W. C. Austin Project

by MATTYE WILSON WILLIAMS, Manager, Altus, Oklahoma, Chamber of Commerce

All the folks on the W. C. Austin project, near Altus, Okla.—the first and only project constructed to date by the Bureau of Reclamation in the State—surely do like to have company.

These folks in southwestern Oklahoma are a friendly lot; and they're powerfully proud of their project, now nearing completion.

What's more, this project is smack on the road home for a great many delegates who will attend the National Reclamation Association Convention in Oklahoma City, November 17–19.

Convention delegates who accept an invitation to visit the project on Saturday, November 20, will have a mighty good time and a view of one of the prettiest reclamation projects in all the West.

The highways from Oklahoma City to the project area beyond to Amarillo, Fort Worth or El Paso, Tex., Denver, Albuquerque, Phoenix and everywhere west are excellent. (See map on next page.)

Convention delegates are invited first to the city of Altus. There, at the Chamber of Commerce, they will be provided with literature about the project, maps of the district and a personal guide to conduct them through the project and thence to Quartz Mountain State Park, close by the project area, where they will be guests of the project folks for a spell of refreshments by rock fireplaces in the park's picturesque Community Building.

There is no set hour for arriving in Altus or touring the project. Visitors may arrive at any hour during the day. Then, when they decide they must light out for home, they'll be free to take to the open road.

The project tour will include a view of late fall crops under irrigation, the structure of canals and laterals, the modern system of engineering that made possible this ultra-modern reclamation project, including siphoning of water under the North Fork of Red River and over a mountain to the fertile soils over which it supplements the 26-inch natural rainfall of the area.

Altus Dam stores 152,000 acre-feet of water at Lake Altus needed for the semiarid lands of the tri-county irrigation district.

Waters, which otherwise would be wasted down the North Fork of the Red River and which on many previous occasions have resulted in flood damage, have become a constant supply to correct the uneven balance of natural rainfall.

The W. C. Austin project lies farther east in the subhumid zone than any other ever undertaken by the Bureau of Reclamation.

Top photo: Altus Dam and Reservoir, located 18 miles north of Altus, Okla., on the north fork of the Red River are the principal features of the W. C. Austin project. Center photo: Cotton will be white and ready for picking on the W. C. Austin project when you receive this copy of the *Era*. Bottom photo: Quartz Mountain State Park nearby the project provides a retreat for visitors. *Top photo by Dale A. Hovey, formerly of Region V. Center photo by P. W. George, Region V. Bottom photo by R. N. Reynolds.*

Benefits are not confined to irrigation, however important it is in an area that sometimes experiences blasted hopes for a good crop year. The project also provides an unlimited municipal water supply for the city of Altus, flood control, and recreational facilities at Quartz Mountain State Park near Lake Altus.

The irrigation project is the realization of a dream of the past half century by men of vision. In 1935 a group of men gathered in Altus and enlisted the legal knowledge and support of the late W. C. Austin, who in the next 11 years, as a civic contribution, spent many hours and made many trips to get the project through. So great were his efforts that soon after his death President Truman signed legislation changing the name to W. C. Austin irrigation project.

A memorial has been erected at the dam by southwestern Oklahoma friends of the project's benefactor.

Preliminary survey for the project was initiated in 1936. Two years later the report was released and in 1939 first funds were allocated. Next the district was formally authorized by a vote of 338 to 42, giving Joe B. Zinn, first and only president, and other officials of the Lugert-Altus Irrigation District, the legal power to make contracts with the Bureau of Reclamation. Other board members are Carthal Mock and Bob Minor.

Construction began in 1941. Present plans call for completion of all details and water available to the entire acreage in the summer of 1949.

The project provides one acre foot of water per year for irrigable land in the district. The reimbursable cost of approximately $3,080,000 for Federal irrigation construction is being repaid to the United States Treasury over a period of 40 years, without interest, by the landowners benefitting from the project.

The city of Altus, in return for a stable water supply, underwrote payment of $1,080,000 of the reimbursable portion of the cost. Balance of the project cost was borne by the Department of the Army funds for flood control, by labor and materials contributed by the Work Projects Administration, plus cost of relocation of utilities and transportation arteries.

The dam is of concrete gravity type, a partially curved structure with granite masonry on the upstream face and the downstream faces of nonoverflow sections. It rises about 100 feet above the stream bed and has a crest of 1,160 feet. Four dikes hold back water in low points of the reservoir rim. Largest is Lugert dike, 6,000 feet long and 45 feet above the natural ground surface.

The project water supply is obtained by run-off water from 2,560 square miles of watershed, varying from a few thousand acre feet in dryer seasons to over 300,000 acre feet in abnormally wet years.

About 340 miles of canals and laterals are required to serve the district, centered around the cities of Altus and Blair. These canals vary in capacity from 790 cubic feet per second at the head end of the main Altus canal to a few second feet in the smaller laterals.

Demonstrating how irrigation pays are fields of various crops of alfalfa hay, grain sorghum, Irish potatoes, watermelons grown for certified seed; spinach, cotton, sweet corn, wheat, and oats.

Yields in irrigated areas in the 2 years that water has been available in some sections of the project have been from two to three times those obtained on dryland farms in the same areas. Various processing plants are being attracted to the area and the ultimate success of the W. C. Austin

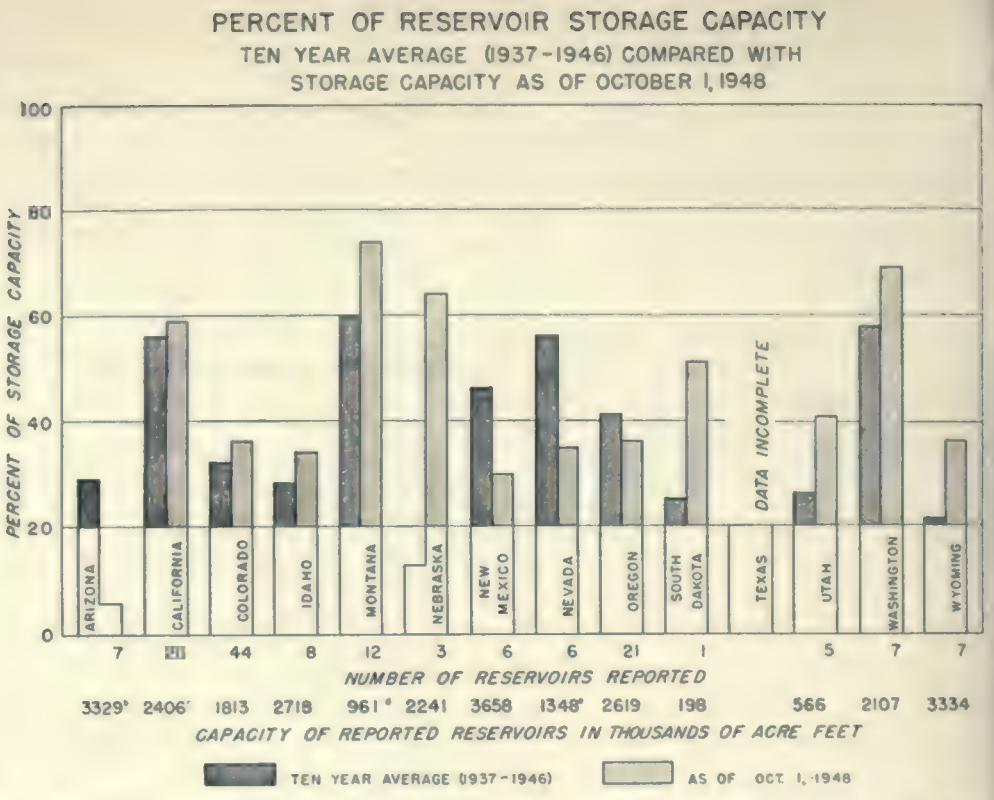
project will be an important factor in spreading the extensive benefits of reclamation eastward in the more favorable rainfall regions of the Nation.

Convention time for the National Reclamation Association will be cotton picking and row crop harvest time for folks on the W. C. Austin project. But they're planning to knock off work on Saturday, November 20, and show everybody who comes to see them what reclamation is doing for Oklahoma. THE END

Index and Bound Volumes

As an economy measure, volumes 33 and 34 (1947 and 1948) of the RECLAMATION ERA will not be bound, as has been the custom in the past. Separate copies of the index will be printed as soon as possible, and will be available free upon request.

WATER REPORT



Not all reservoirs in all States are reported, but enough are reported to give a reliable index of each State's storage supply.

(b) Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included.

(c) Does not include Narrows (Yuba River), Friant or Shasta Reservoirs. September 30 storage in these three reservoirs combined is 2,856,500 acre-feet, which is 66 percent of their capacity.

(d) Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet). September 30 storage is 14,820,000 acre-feet.

(e) Does not include Lake Mead Reservoir (capacity 31,140,000 acre-feet). September 30 storage is 22,200,000 acre-feet.

West-Wide Forecasts of 1948–49 Water Supplies Based on Work of the Western Snow Surveys

By Paul A. Ewing, Senior Irrigation Economist, and R. A. Work, Senior Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture.

Next Year's Water

Your weather may have been "unusual," your crops may have been hard-pushed for moisture (though they came through all right), and you probably wonder how irrigation supplies will be next year.

Well, so far as carry-over storage may promise, Western water supplies in 1949 will be normal—may be a little better than that. There are some bad spots, but a survey of 147 reservoirs, widely scattered throughout the Western States, shows that total October storage is about 106 percent of the corresponding 10-year average. Specifically, as reported by the Division of Irrigation and Water Conservation, Soil Conservation Service, the 147 reservoirs (not including Lake Mead, Fort Peck, and three large California lakes) hold 10,809,000 acre-feet; the 10-year average was 10,150,000 acre-feet. But total capacity of the 147 reservoirs is 27,298,000 acre-feet, so that winter and spring precipitation may double present carry-over and still leave room for more. Later paragraphs and the chart show the present condition of storage, State by State.

The Soil Conservation Service is the agency with which the Bureau of Reclamation has cooperated during recent years in water-supply forecasts based on snow surveys. An interesting feature of this cooperation has been the recent close integration of effort between these two agencies and the United States Forest Service in extending and mechanizing broad snow-survey networks in Montana and Wyoming.

Other agencies are involved in snow surveys. They include the Geological Survey and National Park Service, many irrigation districts, power companies, and the States themselves. Soil Conservation Service coordinates its own surveys with those of the other agencies in an effort to produce forecasts of West-wide significance. Some of the States do a similar job for their own interests. California, for instance, through its Division of Water Resources, makes its own forecasts, which are widely accepted by irrigation, power, and municipal interests.

Reclamation Era published the 1948 forecasts in its May issue. The following paragraphs tell how they turned out.

Accuracy of 1948 Run-Off Forecasts

Minor to noticeable departures of stream flow from amounts forecasted by April 1 snow surveys, occurred in various part of the West during the irrigation season of 1948.

The stream-flow year ends September 30. Consequently only a few flow records at the gaging stations are as yet computed. Enough are at hand, however, to provide an index of accuracy of 1948 run-off forecasts from snow surveys.

WYOMING, COLORADO, NEW MEXICO AND MONTANA EAST OF THE ROCKIES.—Forecasts in this area were quite closely borne out by resultant stream flow. Average error of 9 forecasts in the area was 9 percent. In four of 9 cases the error was less than 5 percent, which is probably about as close as the stream flow of some stations can be gaged with precision. In most of these cases, measured flow was less than the forecasted flow, thus reflecting below-normal precipitation which characterized this general area during spring and early summer months of 1948.

NEVADA AND SOUTHWESTERN UTAH.—Stream flows in this area were reduced by as much as 40 percent from the flows forecasted on April 1. It appears that watershed evaporation losses in this area were much greater than normal in the early run-off season of 1948. Chief reason for such accelerated evaporation losses was greater than normal movement of drying winds over the snow fields.

In western Nevada the April 1 forecasts were modified on May 1 to account for unusually heavy April snowfall, which was approximately 300 percent of normal. The May 1 forecasts of run-off were quite accurate, the difference between forecasted and obtained flow as a percentage for various streams, ranging as follows:

	Percent
West Carson at Woodfords	0
East Carson near Gardnerville	6
Carson River at Fort Churchill	4
Carson River near Carson City	14
West Walker near Coleville	1
East Walker near Bridgeport	2
Lake Tahoe (maximum storage)	8

CALIFORNIA.—The California water-supply outlook was dismal on April 1, but heavy precipitation and resultant heavy mountain snowfall during April, subsequent to release of the April 1 water forecasts, did much to improve the water supply. In places, April snowfall ranged up to 400 percent of normal. This had the effect of greatly increasing run-off from the amounts forecasted on April 1. On a few streams the run-off did not differ materially from the April 1 forecast. These include: Feather River, error of forecast 2 percent; Yuba River, error of forecast 5 percent; Kings River, error of forecast 8 percent; Kaweah River, error of forecast 8 percent. In all cases except Kern and Kings Rivers, the actual run-off exceeded the forecasted run-off, owing to precipitation greatly above normal during April.

OREGON.—As in California and the Pacific Northwest in general, spring precipitation in Oregon was very much above normal. Snow continued to pile up at higher altitudes through the month of April. This produced stream flow greater than that forecasted from snow surveys on April 1. April to June precipitation ranged from slightly above normal in the Owyhee Basin to 262 percent normal in the John Day Basin. For Oregon as a whole, April to June precipitation was about 160 percent of normal.

Very few flow records of forecasted streams are as yet available but all of those at hand show that the forecasts generally will be exceeded by measured April–September flow. This is illustrated as follows:

	Forecasted		Obtained
	April 1	May 1	
	Acre-ft.	*Acre-ft.*	*Acre-ft.*
Owyhee River above Owyhee Reservoir	150,000	225,000	234,620
North Fork, Rogue River	315,000	325,000	330 000
Upper Klamath Lake inflow	421,000	435,000	475,000
Gerber Reservoir inflow	6,000	14,500	21,940
Clear Lake Reservoir inflow	14,000	41,000	66,850

COLUMBIA BASIN (WASHINGTON, IDAHO, PARTS OF MONTANA AND OREGON).—Stream flow, without exception in the data at hand, exceeded the amount forecasted on April 1. There appear to be two chief reasons for the difference:

1. *Precipitation over the northern and western part of Columbia Basin was markedly above normal in both April and May. In May it ranged up to as much as 400 percent of normal. For Oregon as a whole, precipitation for April to June, inclusive, was about 160 percent of normal.*

2. *Above-normal temperatures both day and night through the latter part of May and toward mid-June resulted in greater than usual water yield from the snow pack. This was due to accelerated snow melt and rapid run-off. Relatively less water infiltrated into watershed soils. This resulted in decreased opportunity for evapo-transpiration by watershed cover.*

The Status of Storage

The October 1 status of the carry-over, summarized State by State, is as follows:

ARIZONA.—The water shortage for Arizona was not relieved during the summer of 1948. To date, the extended drought continued and if greater than normal winter storms are not forthcoming during the coming season, the outlook for next summer will be for an extremely short water supply. Reports on seven Arizona reservoirs as of October 1, 1948, show that total storage on that date is only 6 percent of capacity and 21 percent of the 1937–46 average for October 1. Lake Mead, as of October 1, 1948, contained 79 percent of usable capacity and 96 percent of the 1938–46 average.

CALIFORNIA.—As the opening of the rainy season is approached, California is better protected by stored water than was the case last year, only a few reservoirs holding less water than the amounts reported at the corresponding 1947 date. Thus 30 reservoirs above Sacramento and San Joaquin valleys held 4,663,195 acre-feet on September 30, 1948, or 64 percent of capacity, as compared with 3,656,631 acre-feet, or 50 percent of capacity on September 30, 1947. The 1948 storage was 127 percent of the 1947 total. By watersheds, the comparisons are as follows:

Watershed	Number of reservoirs	Capacity	Water stored	
			Oct. 30, 1947	Oct. 3011948
		Acre-ft.	*Acre-ft.*	*Acre-ft.*
Sacremento	1	3,806,000	2,292,000	2,665,600
Feather	4	826,800	499,627	697,237
Yuba	6	312,600	121,154	202,591
Bear	1	7,180	1,110	300
American	2	30,200	13,248	19,618
Mokelumne	2	349,000	225,892	277,609
Stanislaus	3	145,500	20,133	33,103
Tuolumne	5	702,000	210,888	356,428
Merced	1	281,000	4,400	28,600
San Joaquin	5	854,400	268,179	382,109

COLORADO.—Forty-four reservoirs with total capacity of 1,812,700 acre-feet, show October storage totaling 36 percent of that amount, as compared with a 10-year average of 32 percent. On the South Platte, storage is above average; on the Arkansas an unusually high carry-over of 147,000 acre-feet in John Martin Reservoir (not included above) will be available for withdrawals in 1949; the flow of Colorado River into Lake Mead was about 10,300,000 acre-feet between April and September.

IDAHO.—Eleven reservoirs have 1,252,607 acre-feet in storage, as compared with 1,426,415 acre-feet at this time last year and a 10-year average of 1,118,297 acre-feet. While the storage is therefore below the total of 1947 at this time, it is better than average.

MONTANA.—Twelve reservoirs, with total capacity of 960,800 acre-feet, show October 1 storage at 74 percent capacity, as compared with 60 percent as a 10-year average. This comparison does not include Fort Peck Reservoir, which on October 1 held 14,820,000 acre-feet. Capacity of this reservoir is 19,000,000 acre-feet. The 10-year October average is 9,243,000 acre-feet.

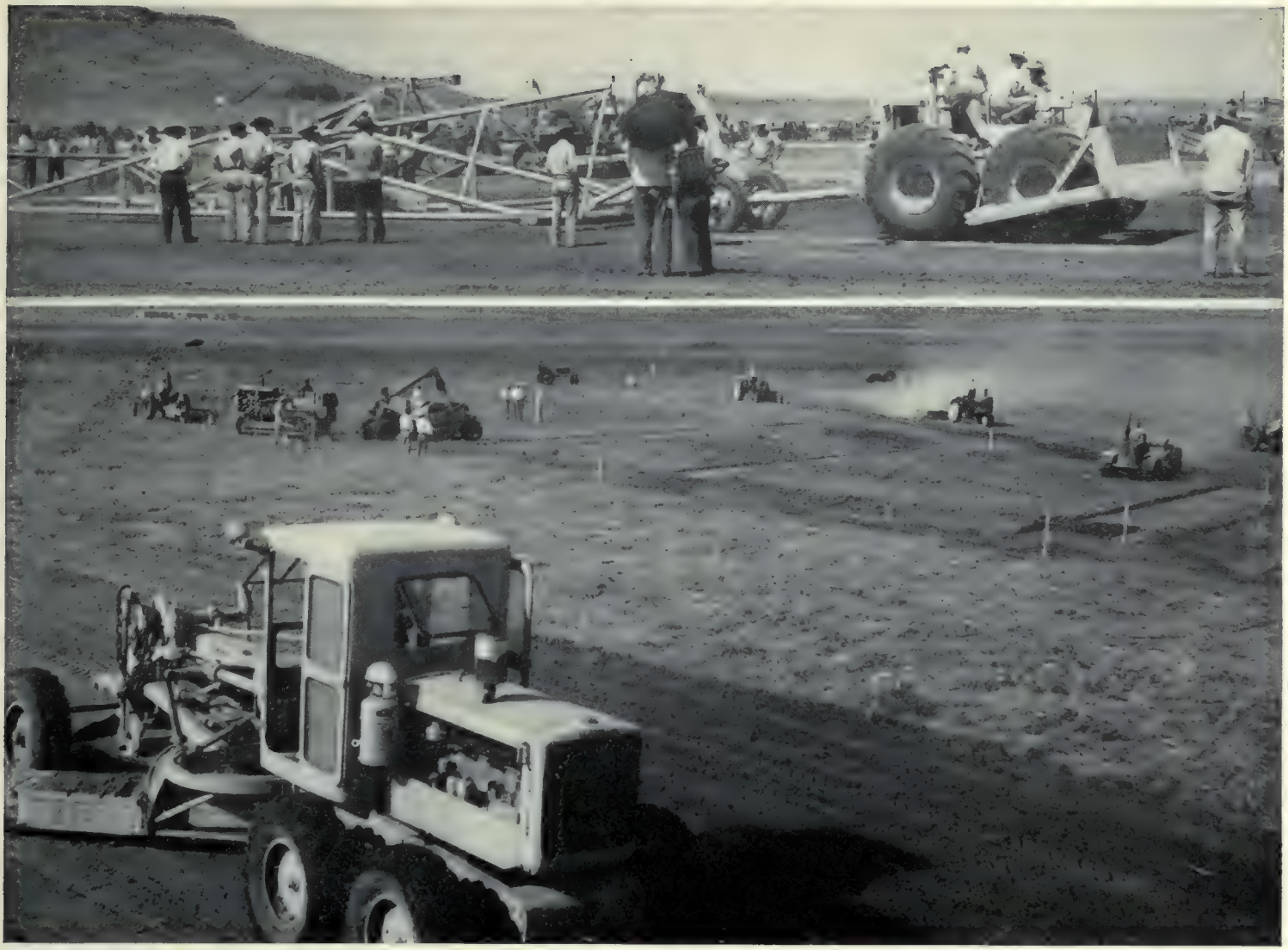
(*Continued on page 220*)

Modern vehicles like this make possible more extensive snow surveys in isolated mountain regions. *U. S. Soil Conservation Service photo.*

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity [1]	Sept. 30, 1947	Sept. 30, 1948
Region 1	Baker	Thief Valley	17,400	700	2,600
	Bitterroot	Lake Como	34,700	10,200	5,000
	Boise	Anderson Ranch	464,200	1,800	12,100
		Arrowrock	286,600	84,100	65,400
		Deadwood	161,900	53,300	69,700
		Lake Lowell	169,000	40,400	41,000
	Burnt River	Unity	24,600	600	7,500
	Columbia Basin	F. D. Roosevelt	5,220,000	5,190,000	5,200,000
	Deschutes	Crane Prairie	50,000	18,100	48,500
		Wickiup	187,000	53,200	24,200
	Minidoka	American Falls	1,700,000	686,800	664,100
		Jackson Lake	847,000	464,000	234,300
		Lake Walcott	95,200	95,200	87,700
		Grassy Lake	15,200	13,200	12,100
		Island Park	127,300	75,500	33,200
	Okanogan	Conconnully	13,000	3,300	9,700
		Salmon Lake	10,500	4,200	8,200
	Owyhee	Owyhee	715,000	252,200	223,700
	Umatilla	Cold Springs	50,000	1,600	9,900
		McKay	73,800	10,600	18,400
	Vale	Agency Valley	60,000	23,600	27,400
		Warm Springs	170,000	11,400	1,200
	Yakima	Bumping Lake	33,800	6,600	7,700
		Clear Creek	5,300	5,300	5,300
		Cle Elum	435,700	146,100	197,900
		Kachess	239,000	141,600	163,800
		Keechelus	153,000	35,800	64,900
		Tieton	197,000	108,300	111,500
Region 2	Central Valley	Millerton Lake	503,100	80,500	132,800
		Shasta	4,389,100	2,166,100	2,539,700
	Klamath	Clear Lake	437,500	142,000	135,600
		Gerber	94,300	14,100	17,900
		Upper Klamath Lake	524,800	142,700	235,000
	Orland	East Park	47,900	4,200	26,400
		Stony Gorge	50,000	1,400	4,700
Region 3	Boulder Canyon	Lake Mead	27,935,000	21,625,000	22,002,000
	Parker	Havasu	688,000	641,500	631,400
	Salt River	Bartlett	179,500	10,500	7,200
		Horse Mesa	245,100	164,300	137,700
		Horseshoe	67,000	8,400	100
		Mormon Flat	57,850	25,600	25,800
		Roosevelt	1,398,400	12,700	5,100
		Stewart Mountain	69,800	19,300	24,300
Region 4	Fruit Growers	Fruit Growers	4,500	900	600
	Humboldt	Rye Patch	179,000	107,300	52,000
	Hyrum	Hyrum	15,300	7,100	5,200
	Moon Lake	Moon Lake	35,800	6,400	1,200
	Newlands	Lahontan	273,600	67,400	108,700
		Lake Tahoe	732,000	387,600	277,200
	Newton	Newton	5,300	2,300	1,300
	Ogden River	Pine View	44,200	12,800	9,600
	Pine River	Vallecito	126,300	95,100	59,900
	Provo River	Deer Creek	146,800	122,000	104,600
	Scofield	Scofield	65,800	13,700	1,300
	Strawberry Valley	Strawberry	270,000	105,500	87,000
	Truckee River Storage	Boca	40,900	10,300	24,400
	Uncompahgre	Taylor Park	106,200	102,100	53,500
	Weber River	Echo	73,900	22,100	7,700
Region 5	W. C. Austin	Altus	140,000	60,500	49,900
	Carlsbad	Alamogordo	128,300	8,600	6,600
		Avalon	6,000	400	3,000
	Colorado River	Marshall Ford	810,500	203,600	242,800
	Rio Grande	Caballo	345,900	12,900	23,700
		Elephant Butte	1,817,000	316,900	543,300
	Tucumcari	Conchas	300,000	259,500	225,600
Region 6	Belle Fourche	Belle Fourche	177,500	104,300	100,300
	Milk River	Fresno	127,200	82,700	94,400
		Nelson	66,800	41,400	40,300
		Sherburne Lakes	66,100	4,800	5,400
	Riverton	Bull Lake	152,000	121,400	81,300
		Pilot Butte	31,500	3,800	1,500
	Shoshone	Buffalo Bill	456,600	395,500	338,300
	Sun River	Gibson	105,000	39,300	40,300
		Pishkun	32,050	21,000	16,600
		Willow Creek	32,400	15,000	16,200
Region 7	Colorado-Big Thompson	Green Mountain	146,900	144,600	128,600
	Kendrick	Alcova	190,500	108,900	131,200
		Seminoe	970,000	816,800	673,200
	North Platte	Guernsey	41,050	5,100	19,800
		Lake Alice	11,000	1,100	1,000
		Lake Minatare	57,000	14,500	13,700
		Pathfinder	1,040,500	197,600	158,400

[1] Available for irrigation.



Machines used in the demonstration ranged from a giant Higly Land Plane pulled by a Tournedozer (top), and grader to small farm tractors (bottom).

Remaking a Farm in a Day

by GARFORD WILKINSON, Amarillo, Texas, Region V

The dust clouds that swirled above a section of the Tucumcari, N. Mex., irrigation project on Labor Day were silver lined for J. C. White, a lanky, sun-tanned veteran of World War II.

It was milking time. The sun vanished in a brilliant color of evening drapery and the last particles of wind-blown sand settled earthward. Young White, a new settler on the reclamation project, stood with his family in the farmyard and gazed out across his completely constructed irrigation system. The White family had seen a miracle of farming that day.

Soon after White finished milking that morning, the sun was slanting long, slender rays from the east. The chrome and red rays reflected from farm-home windows and bounced across irrigated fields in a thousand glories.

It was slightly after 6 a. m. when the first of several hundred volunteer workers, using 80 pieces of equipment, began building White's entire farm in one day. Work performed in the following 12 hours was estimated to be worth a minimum of $2,500. And it was said that the value of the 40-acre farm had been increased by a minimum of $4,000.

The demonstration—publicized as "Remaking A Farm In A Day"—was sponsored on the reclamation project by the Canadian River Soil Conservation District, in cooperation with the Bureau of Reclamation, the Soil Conservation Service, and the New Mexico State Extension Service.

At noon, prior to the formal speech-making program on a knoll overlooking the White farmstead, the Tucumcari police department supplied a western-type barbecue with all the fixings.

J. C. Dykes, assistant chief of the Soil Conservation Service, Washington, D. C., outlined the purpose of the demonstration and cited the critical need for an increased national conservation program. G. L. Boykin, associate director of

the New Mexico Extension Service, told of extension's interest in reclamation and conservation work in the State.

Thousands of visitors from 11 States witnessed the dawn-to-dusk phenomena of modern irrigation engineering, men and machinery. The register carried names of persons from California, Illinois, Missouri, Michigan, Kansas, Oklahoma, Colorado, Arizona, New Mexico, Texas, and Utah.

Surveys of the irrigation farm had been made prior to the day of demonstration by the Soil Conservation Service and the Bureau of Reclamation. Terrace lines had been run; calculations had been completed on ground levels; machinery assembled and fuel trucks stationed on the farm.

All day long the farm was the scene of grinding, roaring machines. It was a battlefield—a battlefield for conservation and utilization of man's most important resources. There were no weak links in the supply lines of men or materials. Operators changed shifts at noon and the work continued without interruption. Caterpillar tractors, Ferguson tractors, Farmalls, Allis-Chalmers, Olivers, Minneapolis-Molines, and others were supplied by dealers. Road graders, carry-alls, floats, land planes and huge Graham-Hoeme All-Purpose Plows sliced, graded, leveled and cultivated the fields.

Fields were bordered and floated; a new irrigation system with 35 structures was installed. Approximately 125 feet of ditch had been concrete lined; there was even a demonstration in sprinkler type irrigation. Some of the fields were fertilized with hundreds of tons of manure. Then the land was planted to wheat, alfalfa, and pasture, for White is a dairy farmer. Water began to flow from nearby irrigation channels constructed by the Bureau.

The 42,000-acre project, now nearing completion by the Bureau of Reclamation, had been the center of one of the most spectacular agricultural events in the history of the Southwest.

"This is a much more significant occasion than may be apparent to the most of us at first glance," said Bureau of Reclamation Regional Director H. E. Robbins, in an address before the thousands of spectators. "Today we are witnessing the task of remaking a farm in a day. We see modern machinery achieving goals of modern soil and water engineering. We are witnessing the coming together here of friends and acquaintances, some from great distances, to observe the application of a science developed by skillful men to protect and conserve the soil and utilize the irrigation water available on a farm in the Tucumcari project area.

"But to me," Director Robbins continued, "these are not the most significant features of this demonstration. The greatest significance, in my opinion, is the spirit of democracy in action, stimulated by the people and their public servants in a coordinated effort to keep democracy alive and functioning through all time.

"The remaking of this one farm here today is not greatly important in itself, for it is but an infinitesimal part of the national pattern that must be woven across our fields and forests if we are to prevent the destruction of our country and, of course, the subsequent destruction of democracy itself."

Director Robbins said it was the spirit of the occasion that impressed him rather than the occasion itself. "This spirit multiplied many thousand-fold would soon overcome much of the Nation's losses which were taken through greed and lust for immediate profits, with no concern about those who live today or those who will follow after we are gone.

"This," he declared, "is a dramatic example of what can be done to conserve America's greatest resources and of the thing that must be done, not only in the Tucumcari project area; not only in New Mexico, but in every river valley and across every field and forest site in America if we are to have the abundance for all as God and Nature intended."

Director Robbins praised the cooperative effort of the various local, State and Federal governmental agencies, citing it as another example of unified service available on western reclamation projects. THE END

Illustrations in this article were made possible through the courtesy of the U. S. Soil Conservation Service, and the Amarillo, Tex., Daily News.

At left: J. C. White, whose farm was rebuilt in a day, observes the "miracle" brought about by cooperation and teamwork with Wayne Miles, SCS official of the Canadian River District. Center: C. A. Stinson and son refueling from mobile station. Right: Tucumcari's Police Chief Jack Nichols serving barbecue.

Project Repayment Contracts— Custom Tailored

by ROLAND V. SNOW, Region I, Boise, Idaho

Most irrigation farmers are well aware that water costs are necessary. But it is surprising that many farmers on projects constructed with Federal funds do not know that only part of the annual assessment is for operation and maintenance, and that in addition a slice goes to pay project construction costs. Too many farmers are content to let their interest in the irrigation system stop at the headgate, and cuss the ditch-rider or the project manager if things don't go right.

Since 1902 the Bureau of Reclamation (until 1923 known as the Reclamation Service) has been building irrigation projects in the Western States. Up to 1947, 298 separate contracts had been entered into by water users for repayment to the United States of reimbursable funds expended. The money spent is interest-free, since the people of this Nation have recognized, through their duly elected representatives in Congress, that every project contributes to the national well-being over and above direct benefits from irrigation, power, flood control, fish and wildlife, and recreation.

The Reclamation Act of 1902 called for repayment of construction costs in 10 years. Later statutes have authorized longer repayment periods. The Omnibus Adjustment Act of May 25, 1926, lengthened the repayment period from 20 to 40 years and required that repayment contracts on new projects should be made only with water users' organizations. The Reclamation Project Act of 1939 authorized the making of new contracts, gearing payments to the ability, year by year, of the farmers to make payments.

The various laws passed since 1902 have been evidence of the need for more realistic repayment terms. Many of the early contracts were drawn up before cropping patterns became established. In other cases, pressures for getting projects into operation were so great that insufficient time was available for classification of soils or analysis of the ability of project farms to pay construction charges. The depression of the '30's proved that the terms of many contracts were not sufficiently elastic.

Prior to World War II there was recognition within the Bureau of Reclamation of the need for repayment contracts to be "custom tailored" to the economy of each project, rather than to make all contracts conform to the terms of an overall law such as the 1939 Reclamation Act. This was particularly true for those projects on which construction costs were obviously too great to be repaid in 40 years. However, World War II delayed the necessary adjustment program.

In 1945 the Washington and Regional offices were staffed

Author Snow talks it over with farmers on the Deschutes, Oregon, project. Left to right: Snow, Ben Evick, K. S. Green, and Dave Green.
Photo by Stanley Rasmussen, Region I

to begin a program of field investigations on projects needing reconsideration of contract repayment terms. Since these investigations involve a thorough economic analysis of operations on individual farms, agricultural economists have been relied upon to do a large part of the work. The program has gone forward and a number of reports have been written, with contracts drawn up to reflect the resulting findings and recommendations.

Some projects have been studied for the purpose of setting up new repayment contracts. On others, it has been found that the terms of existing contracts called for larger annual payments than water users were able to meet, particularly during periods of low farm prices, in which cases existing contracts needed to be amended or superseded.

The philosophy that has been adopted in making field investigations under the present program revolves around the assumption that the more you know about a situation, the sounder will be your conclusions concerning it. Operations begin by isolating the problem and bringing all contributing facts into focus. The investigator begins by collecting information. He discusses the project with everyone available who is familiar with it, reviews pertinent files, analyzes State laws, and studies project histories. After such secondary sources are consulted, operations are transferred to the project under study for a closer look.

Some of the questions that have to be answered during the initial stages of contacts with the project usually include: "Is this an attempt to try to get more money out of water users when they can't meet their present payments?" and "Why don't you write off the entire construction charge?" The investigator is glad to answer these and other questions to the best of his ability, since the resulting discussion helps to convince the project manager and board of directors that all he is trying to do is call a spade a spade.

Aside from contacts with project officials, assistance and advice are obtained from other Government offices and business establishments so that no important phase of the problem will be overlooked. Such sources are particularly valuable

in providing local information on farm land prices, farm commodity prices, market outlets, marketing practices and problems, credit facilities, assessment and collection of taxes, weed and disease problems, and other significant considerations. Particularly helpful in this respect are the County Agricultural Agents, Soil Conservation Service officials, local bankers, members of cooperatives, and personnel at county courthouses, produce and commission houses, and canneries.

The most important information from this point on consists of first-hand facts from project farmers. Operations up to this point are all preliminary to gathering the information that can be obtained only from project farmers. Project officials help in the selection of representative farms, and farmers are notified of the nature and purpose of the interview. Needless to say, many an interview has started off with mixed feelings. Anyone who knows will agree that if you can come to a meeting of minds on the "highfalutin language," farmers are pretty fair economists themselves. And they aren't inclined to accept without question the views and findings of the college trained agricultural economist minus the calluses which denote familiarity with the business end of an irrigation shovel.

On the other hand, the interviewer knows beforehand that the welcome mat might not be out for him. Sometimes it seems to him that even the farmer's dog has been "coached" a little. At best he expects the farmer to be skeptical about whether the information requested is worth the time it takes.

From such uncertain beginnings the interview usually progresses with increasing understanding. Before it is finished the farmer ordinarily agrees with the objectives to be achieved and is willing to furnish records and opinions to the best of his ability. Many an interview has been interrupted by the interviewer staying for dinner at the farmer's insistence. Such cooperation is testimony of the soundness of the program, and proof that the Bureau is right in relying even more heavily on project farmers' help in working out project problems.

Farm records of operations for one calendar year, from approximately 10 percent of project farms selected to represent significant groups, are collected and analyzed with the help of general information on prices, farm operating costs, climate, markets, family living requirements, and project operation and maintenance expenses. The purpose of the analysis is to find how much per irrigable acre the majority of project farmers can pay on the construction debt in a year when prices and costs are in line with long-time or average conditions. This would be called the "base rate." Averages for the six years from 1939 to 1944 are used in this connection for most prices and costs. Project officials and farmers help to make the base rate reflect actual conditions. Cooperation at this point pays big dividends in the long run by making the resulting recommendations more authentic and also by demonstrating to the project manager and board of directors that an honest effort is being made to solve the repayment problem. That this latter point is of no small importance was voiced by one project official who stated: "We know that figures don't lie, but we're not so sure that liars don't sometimes figger."

After the base construction rate is finally determined, a recommended procedure is included in the report for varying construction assessments each year in accordance with the ability of project farmers to pay during periods of fluctuating economic conditions. In addition, all other phases of the repayment problem are presented in the formal report and repayment plan. After approval by the Bureau's Regional and Washington offices, the report and repayment plan is submitted to project water users for consideration and approval.

The repayment contract is drawn up, using the report and repayment plan as a guide, and presented to project water users. The water users then decide whether they believe the contract should be adopted. It is at this point that previous cooperation between the Bureau and the project officials and water users acts as "bread cast upon the waters." The mutual confidence that has been built up can and does eliminate haggling, delays, and misunderstandings that might come about otherwise.

The period of repayment for many projects for which financial readjustment is now being considered will exceed the present legal limit of 40 years. This means that Congressional approval will be necessary. After favorable action by Congress, the repayment contracts will be executed on behalf of the Government and project water users will begin paying for construction according to terms of the new contracts. And you wouldn't lose by betting that the pay-out record will be better, because it will be sustained by a sound foundation of facts and supported by a mutual, and in many cases a new, spirit of cooperation. THE END.

New Electrical Power Developments in Europe

(*Continued from page 208*)

stability load limit by about 25 percent for long transmission lines.

There is a definite trend in Europe toward the application or air circuit-breakers for high-voltage transmission lines. In the United States, only oil circuit-breakers are used on such lines. Four main reasons were given as an explanation for the trend toward air circuit-breakers: shortage of oil in Europe; fire hazards of oil circuit-breakers, particularly during bombings; ease of maintenance of air circuit-breaker contacts; and performance of air circuit-breakers, now approaching that of oil circuit-breakers in the United States. Thus, by necessity, European engineers are developing air circuit-breakers which may have advantages over our oil circuit-breakers, just as necessity has forced the application of extra-high voltage transmission lines in Europe.

Conferences of the C. I. G. R. E. caliber are excellent media for the discussion of technical problems confronting engineers from all countries. By such free interchange of information and ideas, as existed at this conference, new approaches to common difficulties can be found and duplication of research can be avoided. The trip to Europe and the attendance at the international conference have given me a new perspective on the widespread technical advancements being accomplished by engineers throughout the world. THE END

News Round-Up

Minidoka Opening Scheduled

Applications are now being mailed to homeseeking veterans of World War II for 46 irrigated public land farms on the Bureau of Reclamation's Minidoka project located near Twin Falls, Idaho.

All applications received by December 30 will be considered as having been filed simultaneously. Both men and women are eligible to file, but married women must be heads of families in order to file. Approximately 3,600 acres of irrigated land in the Hunt Unit of the Minidoka project comprises the 46 farms.

Staple crops in the locality include alfalfa, wheat, barley, oats, beans, potatoes, and sugar beets. The area is also good for dairying, raising cattle, hogs and poultry.

Cooperative Pre-Survey on Land Classification Methods

As a result of an informal cooperative agreement, representatives of the College of Agriculture, University of California, and of the Regional Salinity Laboratory, the Lower Colorado River Research Project, and the Division of Soil Survey of the Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture, met with Bureau of Reclamation land classification specialists at Yuma, Ariz., on June 2 to 4, 1948, for the purpose of conducting a preliminary inspection of the Pilot Knob and West Mesa areas of the All-American Canal project in advance of the actual land classification.

The members of the party examined the standards and methods used by the Bureau in its land classification procedures and then toured the areas involved. Although the entire proceedings were strictly informal, Bureau personnel had the benefit of a complete and thorough analysis by the other representatives of the methods and procedures proposed for classifying the West Mesa and the Pilot Knob areas. Those participating in the tour mutually agreed upon the standards to be used in the classification, and several representatives of the participating agencies commended the Bureau of Reclamation for its thorough and up-to-date methods of classifying lands.

Central Arizona Project Report Sent to Congress

The Department of the Interior's project planning report on the Central Arizona project was formally sent to the Congress late in September. The report in no way attempts to decide or prejudice the California-Arizona water controversy on the Lower Colorado River.

The giant project has been found economically feasible by Secretary Krug who recommended that the Congress authorize its construction if Arizona's claims upon the Colorado River are substantiated to a degree that would provide sufficient assured water for its operation. Estimated benefits from the project, designed to meet Arizona's critical water shortage and ease the Southwestern power shortage, would exceed the estimated $738,408,000 cost by 50 to 60 percent.

The project plan calls for increased water supplies acutely needed in the highly developed Central Arizona area, including Phoenix. The Bridge Canyon Dam and power plant, which would be constructed to provide power needed for pumping water for diversion to central Arizona, would in addition produce hydroelectric power sorely needed by California and Arizona and other lower Colorado River Basin States.

"The showing in the report of the availability of a substantial quantity of Colorado River water for diversion to Central Arizona for irrigation and other purposes is based upon the assumption that the claims of the State of Arizona to this water are valid," Secretary Krug said in his letter of transmittal.

Power Supply Plan for Nebraska

Interior Secretary J. A. Krug recently announced that a plan is being worked out with Nebraska agencies for the marketing of hydroelectric power in that State in cooperation with the public power systems so that the benefits of low-cost power will be widespread and will accrue to the ultimate consumer.

All electric power utility systems in Nebraska are publicly owned, and no private utilities serve the area.

Under this plan, the Bureau of Reclamation, which acts for the Secretary of the Interior in marketing all Missouri River Basin project power, and public power agencies in the State would individually market power in that part of Nebraska lying west of the 101° 20 meridian. The Nebraska Public Power System would, in effect, be the sole marketing agent in the territory east of this line which is its normal operating area, except for the area served by the Omaha Public Power District.

The arrangement with the Nebraska Public Power System would provide for that system transmitting or "wheeling" Bureau power to other Federal agencies or establishments in the area served by the system, whose individual requirements are in excess of 2,500 kilowatts.

Although rates for the sale of power to the system have not been fully determined, it is expected that savings which will accrue from purchase of power will be passed on to the ultimate consumers in reduced rates.

Another Klamath Land Opening Scheduled

December 20 will mark the day on which veterans of World War II must have filed their completed homestead applications in order to receive considerations for one of the 86 homesteads on the Klamath project in Northern California which the Bureau of Reclamation plans to award soon.

All complete applications filed by veterans previous to

the deadline day (December 20) will be considered as having been "filed simultaneously," and all will receive an equal chance in the drawing. The opening took place on September 21.

Notices and applications have been mailed to an estimated 20,000 persons who have already requested them.

The land comprises 86 new farms ranging from 72 acres to 135 acres, located on an established project where about 1,000 irrigated farms and a thriving agricultural and industrial community have been carved out of arid lands since the first Reclamation construction was started under the act of 1902. This will be the third homestead opening on the project since the end of the war.

Applications will be considered for awarding the farms in the order in which the names of the individuals are drawn from a bowl. Veterans' applications will be considered first. If any farms remain unclaimed, which the Bureau of Reclamation believes unlikely, consideration will then be given to nonveterans who have filed complete applications prior to the deadline. And, if any farms still are unclaimed, consideration will be given to persons filing complete applications after the deadline, in the order in which their applications were filed. However, this is most doubtful judging from experience with past openings.

A local examining board will review the applications in the order in which the names are drawn from the bowl to determine whether the persons fully meet qualifications for homesteading irrigated public lands. Among the qualifications to receive a farm, a person must have had at least two years of full-time farm experience or its equivalent, gained since his or her 15th birthday. Required is a net financial worth of at least $2,000 in cash or assets readily convertible into cash, or else the equivalent in such assets as livestock, farm machinery and equipment which would be useful in developing and operating a new irrigated farm. Both men and women may apply.

Details of the opening are contained in Klamath Project Public Notice No. 47, being mailed out to all persons who have requested them. Others may obtain them by writing either to the Klamath District Office, P. O. Box 312, Klamath Falls, Oreg., or the Regional Director, Bureau of Reclamation, Box 2511, Sacramento, California; or the Commissioner of Reclamation, Washington 25, D. C. Application blanks and instructions are attached to the notices.

"Technical News" Available

Commissioner Michael W. Straus recently called to the attention of all Bureau employees the availability of the publication entitled "Technical News."

This is a nongovernment publication, the official organ of the Technical Club with headquarters located in Denver. The club is a private organization which makes a substantial contribution to the Bureau of Reclamation by providing Bureau professional personnel with a vehicle for the exchange of technical information of general interest.

Subscriptions to the paper or membership in the club may be had by addressing the Secretary, Reclamation Club, P. O. Box 2852, Denver 15, Colorado.

National Reclamation Association Convenes

(Continued from page 204)

quainted with soil and water resources development in Oklahoma. The invitation, signed by Zoe B. Zinn, President, C. F. Mock, and R. W. Minor, Directors of the Lugert-Altus Irrigation District, and President W. O. Goodman of the Altus Chamber of Commerce stated, "Altus is the irrigation pioneer of Oklahoma and the Lugert-Altus District is the first reclamation project in Oklahoma. Information you receive from a tour of the district will be valuable to you and your local projects.

"Refreshments will be served during the day to project visitors in the Community House at Lake Altus. Guides will direct individuals on a tour of the project. Visitors will see harvest operations, crops under irrigation, recreational areas, farm experiment developments, soil conservation, and special modern engineering features."

In the Zebra Room of Oklahoma City's Municipal Auditorium 25,000 square feet of floor space will be devoted to the exhibits pertaining to Reclamation, States and commercial interests, including an exhibit of the latest innovations in irrigation farm machinery.

Many events have been planned in connection with the convention, including a leisure-time program for the ladies with a style show, reception at one of the exclusive clubs, and other special entertainment. A tour of Oklahoma City, stopping at many points of interest, including open-houses at homes displaying the most modern trends in home building, conveniences, and comforts will also be on the schedule.

WATER REPORT (Continued from page 213)

NEBRASKA.—Three reservoirs with capacity of 2,240,800 acre-feet, are holding 74 percent of that amount, as compared with a 10-year October average of only 13 percent.

NEVADA.—Reports from six reservoirs show October 1 storage of 35 percent of capacity and 61 percent of the 10-year October average.

NEW MEXICO.—Storage does not compare favorably with that of October 1947.

The 1948 summer was dry except for the extreme northern part of the State. Flow of the Rio Grande into Elephant Butte Reservoir is estimated to have been 24 percent less than the forecast of April 1, but irrigation demand in the lower Rio Grande Valley was unusually high. Storage in the Elephant Butte Reservoir is substantially the same as for April which is much lower than was anticipated. Storage in El Vado Reservoir, which serves the middle Rio Grande area, is 145,000 acre-feet, which is considerably above normal.

Six New Mexico reservoirs, with total capacity of 3,657,800 acre-feet, reported October 1948 storage of only 29 percent. The 10-year October average is 46 percent.

OREGON.—Oregon's reservoirs, 21 in all, show October 1948 storage as 37 percent of capacity, as compared with a 10-year average of 42 percent. (Total capacity of these reservoirs is 2,619,000 acre-feet.)

TEXAS.—Incomplete reports indicate that October 1 storage in two large reservoirs (Marshall Ford and Buchanan) totals 1,298,600 acre-feet, which is 45 percent of capacity. This storage equals 87 percent of the 1939–48 October 1 average storage for Buchanan Reservoir and 70 percent of the 1942–48 October 1 average for Marshall Ford Reservoir.

UTAH.—October storage in 9 reservoirs is 234,360 acre-feet, or 41 percent of capacity. This is substantially better than the 10-year average for October 1—144,958 acre-feet, or 25 percent of capacity.

WASHINGTON.—A better than average carry-over is in 8 major reservoirs with combined capacity of 2,106,600 acre-feet, the October 1948 figure being 1,465,590 acre-feet, or 69 percent of capacity, as compared with the 10-year average of 1,231,070 acre-feet, or 58 percent.

WYOMING.—Carry-over in 9 major reservoirs (not including Jackson Lake) was 1,050,000 acre-feet on October 1. This was more than twice the normal amount for that date, the current percentage being 39 as compared with a 10-year average of only 14 percent. Storage in Kingsley-Sutherland reservoirs is about where it stood on April 1.

THE END

NOTES FOR CONTRACTORS

Contracts Awarded During September 1948

Specification No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2260	Colorado-Big Thompson, Colo	Sept. 2	Outdoor power transformer for Wiggins substation	Maloney Electric Co., St. Louis, Mo	$33,965
		do	Outdoor power transformer for Brush substation	Westinghouse Electric Corp., Denver, Colo	40,424
2270	Hungry Horse, Mont	Sept. 3	Two 290-ton motor-operated cranes and lifting beams	Shaw-Box crane and hoist division, Manning, Maxwell & Moore, Inc., Muskegon, Mich.	395,103
2278	do	Sept. 8	Two 96-inch steel outlet pipes and appurtenances for dam and power plant.	Pacific Coast Engineering Co., Alameda, Calif.	137,500
2283	Missouri Basin, Nebr	Sept. 2	Construction of 10,000-kilovolt-ampere substation at Alliance, Nebr.	Evans Electrical Construction Co., Omaha, Nebr	189,760
2286	Lewiston Orchards, Idaho	Sept. 30	Construction of irrigation distribution system main pipe line, Station 0+15 to Station 232+30.	Goodfellow Bros., Inc., Wenatchee, Wash	344,552
2290	Fort Peck, Mont	Sept. 2	Construction of 2,000-kilovolt-ampere substation at Savage, Mont	Elliott Construction Co., Omaha, Nebr	59,925
2292	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 24	Gates and hoists for Coachella Valley and All-American Canals	Isaacson Ironworks, Seattle, Wash	12,200
2293	Missouri Basin, N. Dak	Sept. 29	Steel structures for 115-kilovolt Williston-Garrison dam transmission line.	Daco Metal Products Co., Oakland, Calif	11,014
2297	Missouri Basin, Wyo	Sept. 16	Construction of 6,000-kilovolt-ampere substation, Pine Bluff, Wyo.	Killoren Electric Co., Appleton, Wis	153,000
2313	Colorado-Big Thompson, Colo	Sept. 24	One power, lighting, heating, and direct current switchboard cubicle for Granby pumping plant.	Cutler-Hammer, Inc., San Francisco, Calif	10,477
2315	Central Valley, Calif	Sept. 24	12 bulkhead gates, miscellaneous metalwork for Tracy pumping plant.	Gardiner Manufacturing Co., Oakland, Calif	16,340
2320	Missouri Basin, Wyo	Sept. 8	One 22,500-pound-capacity gantry crane for Kortes Dam	Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.	12,800
2323	Lewiston Orchards, Idaho	Sept. 2	Construction of east portion of irrigation and domestic water pipe distribution systems.	S. M. Gilbert Co., Seattle, Wash	157,350
		do	Construction of west portion of irrigation and domestic water pipe distribution systems.	E. F. Pugsley, Seattle, Wash	116,809
2330	Provo River, Utah	Sept. 13	Construction of pipe line and structure for Salt Lake Aqueduct.	Provo Foundry & Machine Co., Provo, Utah	346,937
2334	Central Valley, Calif	Sept. 21	9 radial gates and equipment for Delta Mendota canal	Berkeley Steel Construction Co., Inc., Berkeley, Calif.	25,047
		do	9 motor-operated radial gate hoists for Delta Mendota canal	Northwest Marine Iron Works, Portland, Oreg.	21,839
2337	Columbia Basin, Wash	Sept. 24	Control-board extensions and instruments for Grand Coulee left power plant.	General Electric Co., Denver, Colo	12,596
2356	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 8	70,000 barrels portland cement for Coachella Valley distribution system, units 2, 3, and 4.	Riverside Cement Co., Los Angeles, Calif	178,500
2357	Columbia Basin, Wash	Sept. 13	Steel structure for right transformer circuits and 230-kilovolt tie circuits for right 230-kilovolt switchyard.	National Iron Works, Oakland, Calif	46,475
R1-21	Boise, Idaho	do	Construction of earthwork and structures C line canal, east laterals and Willow Creek Pump laterals.	Geo. B. Henly Construction Co., Caldwell, Idaho	328,047
H. H.-3	Hungry Horse, Mont	Sept. 10	Clearing part of Hungry Horse Reservoir site	Wixson & Crowe Co., and J. H. Trisdale, Redding, Calif.	1,733,880
R1-25	Deschutes, Oreg	Sept. 20	Pneumatically applied mortar canal sealing, north unit, main canal.	American Gunite Co., Salt Lake City, Utah	21,012
R2-22	Central Valley, Calif	Sept. 16	Dismantling buildings, and construction of residences and appurtenant structures for Government camp, Delano, Calif.	Trewhitt-Shields & Fisher, Fresno, Calif	240,989
R2-32	do	Sept. 7	Furnishing, hauling, and placing gravel, Delta-Mendota canal and Westley wasteway.	Hubert Sykes, Patterson, Calif	13,940
R3-LCRD-3	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 29	Construction of highway and railroad culverts, drain line 8-B, Imperial Division, All-American Canal System.	V. D. Case Co., Long Beach, Calif	109,371
R6-11	Fort Peck, Mont	Sept. 2	Erecting 6 two-bedroom prefab residences and extending utilities at Fort Peck town site.	Elmer Johnson, Glasgow, Mont	33,384
R7-18	Missouri Basin, Nebr	Sept. 1	Furnishing and erecting 30 prefab residences for Government housing at Trenton, Nebr., for Culbertson Dam.	Metcalfe Construction Co., Omaha, Nebr	278,640
R7-22	Mirage Flats, Nebr	Sept. 2	Construction of buildings, sewerage and water distribution systems and residences for operation and maintenance headquarters.	John Keller Construction Co., Longmont, Colo	58,238
R7-24	Missouri Basin, Nebr	do	Clearing Enders Reservoir site, Enders, Nebr	Burks & Co., Denver, Colo	14,753
R7 26	Colorado-Big Thompson, Colo	Sept. 17	Furnish rails, rail accessories, miscellaneous structural steel for Granby pumping plant.	Vulcan Rail & Construction Co., Maspeth, N. Y.	39,772
R7 29	Missouri Basin, Nebr	Sept. 24	Clearing Medicine Creek Reservoir site, Pt. I, at Indianola, Nebr.	Gatewood-Lewis-Hadley, Pryor, Okla	55,853

Construction and Supplies for Which Bids Will Be Requested by January 1949

Project	Description of work or material	Project	Description of work or material
Boise, Idaho	Autotransformers, lightning arresters; instrument transformers, and metering equipment for Anderson Ranch switchyard.	Klamath, Calif.-Oreg	Improvements of Lost River channel in Langell Valley, near Klamath Falls, Oreg.
Boulder Canyon, Nev	Processing of sand and gravel for concrete aggregate.	Lewiston Orchards, Idaho	Construction of filter plant and Clearwater reservoir to supply water to domestic and irrigation distribution systems near Lewiston, Idaho.
Do	Construction of 15 permanent houses at Boulder City, Nev.		
Central Valley, Calif	Relocation of 7.2 miles of railroad spur above Keswick reservoir, between Middle Creek and Matheson.	Missouri Basin, Mont	Construction of about 8 miles of canal and laterals for the Savage Unit, near Savage, Mont.
Columbia Basin, Wash	Construction of North dam, an earthfill structure about 2 miles southwest of Coulee Dam, Wash.	Missouri Basin, Nebr	Construction of earthwork and structures for about 16 miles of Courtland canal, near Superior, Nebr.
Do	Construction of earthwork and structures for about 14 miles of the West canal, near Ephrata, Wash.	Do	Construction of earthwork and structures for about 12.5 miles of Superior canal, near Superior, Nebr.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder canal near Coulee Dam, Wash.	Do	Construction of earthwork and structures for about 6.5 miles of Cambridge canal, near Oxford, Nebr.
Do	Four power circuit breakers for 230-kv. right switchyard Grand Coulee power plant.	Do	Furnishing and erecting 20 prefabricated residences for Government Camp at Superior, Nebr.
Davis Dam, Ariz.-Nev	Constructing and furnishing equipment for Blythe substation, 15,000 kva. capacity.	Missouri Basin, Wyo	Construction of about 1.5 miles of access road at Keyhole dam, about 18 miles northeast of Moorcroft, Wyo.
Do	Stringing conductors and installing insulators for 75 miles of 230-kv. transmission line from Davis Dam to Parker Dam.	Do	Elevator for Kortes dam and power plant.
Do	Stringing conductors and installing insulators for 55 miles of 230-kv. transmission line from Davis Dam to Hoover Dam.	Ogden River, Utah	Construction of earthwork and structures for an equalizing reservoir for the south Ogden lateral distribution system near Ogden, Utah.
Fort Peck, Mont.-N. Dak	Construction of 15,000 kva. capacity Williston substation.	Paonia, Colo	Enlargement of about 4 miles of Fire Mountain canal from its present capacity of 70 cfs. to a capacity of 200 cfs. Construction is located near Somerset, Colo.
Gila, Ariz	Construction of 18 miles of the Welton-Mohawk canal, about 20 miles east of Yuma, Ariz.	Tucumcari, New Mex	Construction of last 15 miles of the Hudson canal and construction of lateral unit No. 7, including drains. Construction is located about 15 miles northeast of Tucumcari, New Mex.
Do	Construction of pumping plants 1, 2, and 3 along Welton-Mohawk canal.		

Above left: Bonnie and Laddie "stand guard" over the flock on the sun porch. Above right: Marilyn Sperry, age 3, displays "turkey of tomorrow" in the form of a two-day old Beltsville baby poult. Below: A view of turkeys on sun-porch, their social and recreational area. The "dual-purpose" capes worn by the birds serve to prevent them from pecking each other as well as to preserve the "New Look." See story on page 205. *All photos by Phil Merritt, Region I*

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Reclamation ERA

December

1948

Public Library
Kansas City, Mo.

Bronze beauties from the Roza Divisio
of the Yakima project, all ready for Christma

Merry Christmas!

The horn of plenty is filled with foods of all kinds for the Nation. Thanks to Reclamation's projects. Photo by Phil Merritt and Stanley Rasmussen, Region I.

Reclamation Place Names in This Issue

Reclamation ERA

December 1948 **Vol. 34, No. 12**

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

Mrs. A. W. Williamson, of the Roza project in Washington, holds a golden gobbler, one of 1,800 which she and her husband will send to market during the holiday season. Just one of the remunerative products made possible through Reclamation. This photo was taken by Stanley Rasmussen, Region I.

The Upper Colorado River Basin Compact Is Signed

By N. B. BENNETT, Jr.,
Assistant Director, Branch of Project Planning,
Washington, D. C.

An Upper Colorado River Basin Compact, containing 21 articles, a preamble and a conclusion, was signed at Santa Fe, N. Mex., on October 11. Among the high spots of the compact are article III, providing for the apportionment in perpetuity between the signatory States of the consumptive use of water apportioned to and available for use by the upper basin under the original Colorado River Compact; article IV, providing for curtailment of use by the States in the event of drought or for other reasons; article VIII providing for an "Upper Colorado River Commission," an administrative agency; and articles X, XI, XII, XIII, and XIV, providing for the division of water of various interstate tributaries.

JUNE 6, 1946, WASHINGTON, D. C.—Acting Commissioner of Reclamation William E. Warne speaking: "There is not enough water available in the Colorado River system for full expansion of existing and authorized projects and for development of all potential projects. The formulation of an ultimate plan of river development, therefore, will require selection from among the possibilities for expanding existing or authorized projects as well as from among the potential new projects. Before such a selection for ultimate development can be made it will be necessary that, within the limits of the general allocation of water between Upper Basin and Lower Basin States set out in the Colorado River Compact, the Colorado River Basin States agree on suballocations of water to the individual States."

JULY 22, 1946, CHEYENNE, WYOMING.—Governor Hunt of Wyoming speaking: "Gentlemen, I think you all know why we are assembled here this morning. It is a matter of tremendous importance to the Upper Colorado River Basin States, a matter that now has become almost a necessity that it be done and be done rapidly, if we expect development of the Colorado River Basin in the Upper Basin States to get under way."

OCTOBER 11, 1948, PALACE OF GOVERNORS, SANTA FE, N. MEX.—Federal Representative Harry W. Bashore speaking: "There is about to be signed here a document which will forever be an example of fairness, a demonstration of statesmanship of the highest order, and finally, a proof of the ability of States to deal with their mutual problems, no matter how complex, through the traditional and constitutional compact method."

Thus it started and thus the first step was accomplished.

Behind this simple presentation lies a magnitude of work by men of vision, by men of accomplishment, by men with the best interests of their respective States in mind but fully cognizant of the importance of collective action and of the interests of the Nation. These men must be named, they are: Charles A. Carson, Arizona; Clifford H. Stone, Colorado; Thomas M. McClure (deceased) and Fred E. Wilson, New Mexico; Edward H. Watson, Utah; L. C. Bishop, Wyoming; and Harry W. Bashore, Representative of the United States.

Counting the original meeting of the Governors in Cheyenne on July 22, 1946, there was a total of nine formal meetings of the Compact Commission and their Advisors. At the organization meeting at Salt Lake City, Utah, July 31, 1946, the Commission recognized the immediate need for a committee of engineer advisors. This committee was quickly formed, consisting of: J. R. Riter, Bureau of Reclamation, chairman; R. Gail Baker and R. I. Meeker, Arizona; C. L. Patterson (Mr. Patterson later resigned and was replaced by R. M. Gildersleeve), R. J. Tipton, and F. C. Merriell, Colorado; J. H. Bliss and J. R. Erickson, New Mexico; C. O. Roskelley and F. W. Cottrell, Utah; H. T. Person and R. D. Goodrich, Wyoming. Again the Commission, being fully cognizant of the gravity of its task, appointed a legal advisory committee, consisting of Charles A. Carson, Arizona, chairman; Jean S. Breitenstein, Colorado; Fred E. Wilson, New Mexico; J. A. Howell and E. W. Clyde, Utah; N. B. Gray and W. J. Wehrli of Wyoming. This same group with the addition of J. G. Will, Bureau of Reclamation, as chairman and L. S. Udall of Arizona, served as the drafting committee to translate the principles adopted by the Commission into the written word.

UPPER COLORADO RIVER BASIN COMPACT COMMISSIONERS AND ADVISERS, Santa Fe, New Mexico—October 11, 1948, Seated Left to Right: Judge Howell, Legal Adviser for Utah; Wm. R. Wallace, Adviser, Utah; Ed. H. Watson, *Commissioner for Utah;* L. C. Bishop, *Commissioner for Wyoming;* Grover E. Giles, *Attorney General, Utah;* H. W. Bashore, *Representative of U. S. and Chairman of Compact Commission;* Chas. A. Carson, *Commissioner for Arizona;* Fred Wilson, *Commissioner for New Mexico;* Judge Clifford H. Stone, *Commissioner for Colorado. Standing Left to Right:* Tom Jensen, *Utah;* Dan Hunter, *Dove Creek,* Colo.; Judge M. A. Threet, Albuquerque, N. Mex.; John Erickson, *State Engineer's Office, Santa Fe, N. Mex.;* Ralph Meeker, *Engineering Adviser, Arizona;* R. J. Tipton, *Engineering Adviser, Colorado;* I. J. Cory, *Farmington, N. Mex.;* J. R. Riter, *Chief Hydrology Division, Branch of Project Planning, Bureau of Reclamation, Denver, Colo.;* J. S. Breitenstein, *Legal Advisor, Colorado;* John G. Will, *Assistant Chief Counsel, Legal Advisor to the Representative of U. S.;* H. H. Christy, *Colorado;* John Bliss, *State Engineer, Santa Fe, N. Mex.;* and William Wehrli, *Legal Adviser, Wyoming.*

What the Commission and the advisory committees accomplished is perhaps best expressed in the words of Harry Bashore:

"The Upper Colorado River Basin Compact * * * will be a tower of strength to the States of Arizona, Colorado, New Mexico, Wyoming, and Utah, perhaps for centuries to come. It is a structure for the completion of which we have labored long. It is sound in design. Each part of it has been wrought with great care by men who are notably skilled in their professions and experts in the compact process. It has been builded by men of good faith. It has been builded by men of good will; and because it has been so builded, it will endure."

THE WHITE HOUSE

Washington

NOVEMBER 6, 1948.

DEAR MR. POLK: Recent years have brought a marked change in the scope, size, and character of the National Reclamation Program and have cemented its significance in the Nation's economy. I am highly gratified at the tremendous strides that have been made by my own administration and that of Franklin D. Roosevelt.

Our continuing objective is full mobilization of our water resources. To maintain this resurgence of western progress, we must push reclamation and allied resource developments to still greater heights. We must see that the benefits from irrigation and public power are spread widely among the people so that opportunities for economic security and advancement will be made available to the largest possible number of people.

I favor continuance of the family-size irrigated farm as a means of spreading the agricultural benefits of reclamation to the greatest number of people. I support Federal construction of transmission lines as essential to assuring low-cost public power to the West.

The most recent expressions on the part of the people of the West seem to reaffirm their adherence to those views.

I urge the National Reclamation Association to join with me in pursuing a course that will assure the greatest good to the greatest number.

Very sincerely yours,

Harry Truman

MR. HARRY E. POLK,
President,
National Reclamation Association,
Oklahoma City, Oklahoma.

THE SECRETARY OF THE INTERIOR

Washington

NOVEMBER 11, 1948.

DEAR MR. POLK: Please express to the convention my regrets for not being able to deliver this message in person.

President Truman's program for western development was given a tremendous vote of confidence and support on November 2. And this vote was a vindication of Commissioner of Reclamation Michael W. Straus and Regional Director Richard L. Boke whom the Eightieth Congress wanted to remove from office because of their vigorous and faithful execution of the mandates and objectives of previous Congresses.

The demands for power have so increased that only vigorous development of the Reclamation program will enable the West to meet the vital needs of its expanding population and higher industrial activity. The hand-in-hand development of public power and irrigation projects will speed the full utilization of western water resources. Transmission lines must be built to distribute public power economically and efficiently.

To serve the needs of veterans and others for the family-size irrigation farm, we must continue our support of the Reclamation law. Removal of acreage limitations would seriously retard western development and deprive many thousands of veterans and others of the opportunity to settle on irrigated farms. It would disrupt the establishment of a sound family economy and encourage monopoly.

The administration of the Reclamation law must not be hamstrung by appropriations riders. These must be repealed and avoided if the high objectives of Reclamation are to be met.

We must meet the mandate from the people of the West. We have won support by aggressive and forward-looking programs. We cannot do less for the future. It is a challenge to us all. I know you will accept it.

You have my best wishes for a successful convention.

Sincerely yours,

J. A. Krug

Secretary of the Interior.

MR. HARRY E. POLK,
President, National Reclamation Association,
Oklahoma City, Oklahoma.

"Reclamation Revelations—1948-49"

Commissioner of Reclamation Michael W. Straus, speaking on Friday, November 19, before the Seventeenth Annual Convention of the National Reclamation Association which was held at Oklahoma City, Okla., last month, highlighted President Truman's request of the Eightieth Congress last August that the restrictions placed upon the Bureau of Reclamation be lifted, and the original budget requests be restored. The complete text of his address follows.

This is one speech I am really happy to make. Now that the turmoil and shouting of our quadrennial is quieting, I am glad to be with the National Reclamation Association here in Oklahoma and counsel with you again—for the sixth time. There is a report that I have to submit, and there are certain observations and recommendations that are worthy of attention by this organization of which I have been a member for many more years than I have been Reclamation Commissioner.

We have listened to a lot of fine speeches by a lot of personages who have appeared before the National Reclamation Association in the parade of passing years. And listening, I, like any of you, have always pondered the motives, the angles, the influences, and the interests behind the various views that these orators voiced. Certainly, I have never heretofore uttered to you a single word without calculation and hope that it might help win for Reclamation something that Reclamation needed—perhaps, some money from the Congress or some policy designed to benefit and protect Reclamation.

Today you meet on one of those joyous occasions when you need not rack your minds for a single moment on any such mystery as to motives. For the first time in the history of the National Reclamation Association, you are hearing a speech warranted in advance to be totally devoid of any self-interest. In fact, it is blessed with a special act of the Eightieth Congress intended to guarantee it to be a simonpure 100 percent objective presentation.

The Question of Qualifications

This purity has been attained by a unique process purporting to establish prerequisite qualifications of a Commissioner of Reclamation on which there seems to be a state of mind that is something short of unanimity. The last time that this came up was a few years ago when an incoming administration under President Warren G. Harding decided that the essential qualification for Commissioner of Reclamation was that he must, under no circumstances, be an engineer. Therefore, my distinguished predecessor, Commissioner A. P. Davis, in whose honor the great Davis Dam rising on the main stem of the Colorado River has been named, was thrown out of office. Both he and his bosses stipulated in official writing that he was ousted because he was an engineer and the then-incoming administration knew that Reclamation must not have an engineer—a prejudice I do not share.

Against a parallel background, even including a fight in support of public power that Davis also advocated, I have recently been legislated out of office on the grounds that the vital requirement is that a Commissioner must, under no circumstances, be a nonengineer but must qualify as a professional engineer of 5 years' experience. At least under the present law—or until the Eighty-first Congress reviews the matter and decides otherwise, which is possible—no other brand of Commissioner can be paid for service between 12:01 a. m., February 1, and 12:01 a. m., July 1, 1949. Any lawyer, farmer, editor, or other nonengineering candidates for the job here assembled have only to sit tight until next July and, in the absence of further legislation by the next Congress, they will automatically then become eligible.

Regardless of the logic, if any, of all that and the history and the facts as you know them—and many do because certain of you participated in those exercises—we are all now fortunate in the assurance that one beneficial result is that you are sure to get today an objective presentation. This is no ventriloquist's performance. So, here goes and, instead of taking our text from Exodus (as a preacher might say) today we take our text from Revelations.

But before we get into certain matters of policy, some recommendations that I shall offer, and into discussions of problems with which our National Reclamation Association must meet, let me present to you Reclamation's annual report to the West.

Yardsticks for Construction Progress

Today you have a Reclamation program of unprecedented size, scope, variety, and vigor. We are all glad that it is no longer a little waif hanging around the Nation's back door and occasionally catching a crust. It now stands forth in its own right and speaks for itself. Reclamation has come of age. In doing so, it is emerging from some of the growing pains of adolescence. Let's slap a few yardsticks on it and see how it measures up.

By any yardstick applied, Reclamation has done more work in the last 12 months than in any other year of its half century of existence. And having done that, it has won as its reward an opportunity to do far more during the coming months—an opportunity backed by a $246,058,942 appropriation for the year we are now in—which appropriation, incidentally, has more strings tied on to it, making it harder to use effectively to advance Reclamation, than any other of record. If anyone is interested in mathematical computations or likes to play the numbers game, he can observe that this represents an increase of 270 percent over the average annual regular appropriations for the 10 previous years. And I say that will not be enough for next year—it will not even be enough to continue next year at full scale work which we are starting this year, let alone getting new, authorized and needed works into construction.

Appropriations are merely a Congressional yardstick which has come into popular use. Another measuring rod of the program is work for which funds were available and which Reclamation wanted done but which, for innumerable reasons, was not done—which is another way of describing carry-over funds. These, at the beginning of the fiscal year, were roughly around $31 million compared with $91 million the previous year and $110 million 2 years ago. That shows that we translated more of the dollars that the Nation provided into beneficial works than ever before. I forecast that we will get more work in place this year. We probably will also have a bigger carry-over of undone work due to the new fetters hobbling Reclamation which the Eightieth Congress wrote into appropriation acts.

For the benefit of those many who are myopic enough to see Reclamation only in the terms of construction, let's slap on a third yardstick and read it off in terms of contractors' earnings, which is one way of measuring the works we have built. On Reclamation as a whole, we completed $169 million worth of construction work or 88 percent of the $191 million program laid out in the 12 months preceding the current fiscal year. This was better than the prior year. It looks to me

at the moment as if the total payments for work put in place will be still higher in the current year even though the percentage of completion of a bigger program may be less—thanks again to the tangle of provisos, limitations, and prohibitions that the last Congress clamped on the program and that the next Congress will be asked to strike off. Even so, Reclamation construction under contract today breaks all records with outstanding contracts of a value of about $400,000,000 with a lot more work ahead of the builders than there is behind them.

Construction and appropriation statistics, however, tell only half-truths in measuring anything as dynamic as Reclamation. This association should be less interested in staggering construction totals than it is in the real end results sought in terms of crops and kilowatts. So, let's put on a few more meters on what comes out at the far end.

Value of Crops and Kilowatts

Last year's census of crops produced with Federal irrigation water had a total value of $555 million, approximately $25 million over the previous year. Both construction and crops in dollars reflect inflation. But tonnages and acres don't. The tonnages and acres of Reclamation crops were up as well as the values. Each year, Reclamation registers a new record both in acres watered and in food produced per irrigated acre and in every other way. Stated in different words, the crops produced last year on land under Federal Reclamation water have a value approaching half the total investment of Uncle Sam in Reclamation during a half-century. That's a good return on anybody's money. But we have to do better because there are still a lot of hungry people around in this world—there will be for a long time.

Crops are only one thing produced by Reclamation. We don't put a dollar sign on homes, communities, towns, or cities developed or on the recreational, fish and wildlife, and other benefits. But we do run Reclamation's kilowatts through the cash register. Last year power sales approximated $25 million—cash revenue that helps pay for water, and well up from previous years. That also has got to be better because the lights are still going out around the West. The kilowatts to meet your needs are not yet available—power shortages are getting worse not better—a fact that responsible citizens might remember during these ideological power debates.

I am glad to be able to tell you that the Bureau staffs are right now aggressively shoving the Reclamation program on every front in each of the 17 Western States and doing it against a handicap of an irrational requirement of having less men do far more work than has ever been required of Reclamation heretofore. I have never seen such a splendid staff. You're lucky to have them. It's time this Association recognized them.

Repairs, Repayment, and Ratification

Likewise, in the last 12 months since I have met with you, while a lot of difficulties have not been overcome, a lot have—items that have been drifting for years despite everybody's efforts. Rehabilitation and repairs on Reclamation works which were passed over in war years, with resultant deteriorating canals and weed-grown ditches, are now coming under control. Great structures that have not had the attention and inspection they merit have been brought under strict and scheduled surveillance and inspection. Unrealistic repayment contracts are being revised and brought down to earth. A lot of overdue payments have been made. Certain liberalizations in Reclamation law have been achieved and the way paved for more liberal repayment legislation.

And important agreements have been reached. Outstanding in this category is the achievement of the five Upper Colorado River Basin States—Utah, Wyoming, Colorado, Arizona, and New Mexico—which have, by their own determination aided by the good offices of Reclamation, finally after better than a quarter of a century of wrangling, reached an agreement on what water is whose in the Upper Colorado River Basin. Ratification by those five State Legislatures and consent by the 81st Congress of the United States will permit vast Reclamation development to proceed so that the Upper Colorado River Basin may reach its rendezvous with a rightful destiny.

So much for Reclamation's report. That record is written. Nothing can change it. More recently, Reclamation has been, I was delighted to observe, a major issue in a major political campaign. I happen to be a firm believer in such discussions and like to see the light let in. Every time the spotlight focuses on Reclamation, it benefits. Certainly, these last few months have been marked by examination of the record followed by competition among the candidates to outpledge each other in their devotion to Reclamation. For months now, it has been standard practice that whenever a speech writer got west of the Mississippi River he outdid himself with new-found proclamations of devotion to resource development and Reclamation. The campaign chorus is now over and only the melody lingers on. It was sweet music that was played but the West appears to have detected a few false notes for—at least according to the election returns—it made many changes in the orchestra and told it to follow the tune of the conductor.

The Eightieth Congress

You and Reclamation have a nice problem starting in January with the Eightieth-first Congress as to how the West is going to fare, but I think that on the President's record of performance instead of promise the West will fare quite well. It is no secret that in justifying this year's money before the Eightieth Congress I reported that a sum approaching half a billion dollars would be required next year to carry forward the program that has already been undertaken. During his campaign the President was specific both in his appraisal of Reclamation needs and policies and his views have been ratified.

Your fate was in the hands and under the control of the eastern majority. It is not only the money but also the basic policies and whole fundamental concept of Reclamation that were passing increasingly from western groups under control exercised or imposed primarily in appropriation bills under a variety of disguises. The result of this Appropriations Committee policy control is not a matter of opinion. And it was a mathematical fact that the 17 reclamation States were outvoted in the Eightieth Congress House appropriation groups 3 to 1.

In that Congress, your western groups took some punishment. It made little difference what policies the western Public Lands Committee or the Irrigation Subcommittee decided upon, the Appropriations Committees revised them or reversed them as suited their purpose. Sometimes they merely nullified previous western determinations as, for example, striking out of projects transmission lines that the communities wanted and which the Congress had authorized. Sometimes whole policies were thus reversed, aided and abetted by national lobbies under eastern domination. And this was not confined to projects now under construction, but it went back to laws of long standing upon which you relied. By direct or indirect action, they, through the same process, were reversed without any real consideration. This was done when by imposing an arbitrary personal services limitation on Reclamation staffs, whether or not they are paid by appropriated federal funds or water users' funds, the staffs were so butchered that irrigation districts found they have to take over operations which they had relied on the Bureau to perform after paying for such performance. The

(Continued on page 239)

FARMING FROM THE SKY

Applying commercial fertilizer to a rice paddy near Durham, Calif. Man in foreground waves flag to direct application of fertilizer. Photo by J. E. Fluharty, Region II.

By JOHN A. McKEAG,
Delta District, Region II, Sacramento, Calif.

"Remember dear, fly **low** and fly **slow,**" the nervous mother cautions her pilot son in the old airmen's jest. Her advice has been ignored by most aeronautical researchers in their fight to lick the speed of sound. But it is the motto, the hope and the goal of a small, ill-financed band of resourceful mechanics, farmers, agricultural engineers, and scientists who have been struggling for years along a divergent research path, a path that leads away from man-made meteors and toward an airplane that will be an efficient, all-purpose farm tool. Their odd goal is an aircraft that will just barely jog up and down a field, 5 feet off the ground, making a neat 90° turn at each corner. The final end of their research may sometime be an all-purpose rig that can move along above any 40 acres, sowing, fertilizing, fighting weeds and insect pests efficiently, all the while managing not to kill the neighbors' crops, cows, and bees with drifting sprays: a machine that may even, on occasion, rise up and snatch a needed shower from a passing cloud.

After some 30 years of work (the first recorded use of an airplane in pest control was that of an old Hisso Jenny spraying lead arsenate on catalpa trees in Dayton, Ohio, in 1921) combatting pests with aircraft has become quite a fair-sized enterprise. In 1939 there were about 200 airplanes in the whole country doing such work, but on a scale less modest than their small number would indicate. For that year saw 223,000 acres of crop and range lands, growing some 25 different crops, assailed by 20 different pests, treated with 15 different insecticides and fungicides in California alone. Growth has been great since then with no less than 75 different companies now operating in that single State, some following crops from the Oregon line to the Mexican border. But the picture of their operations is still much as it was years ago—an old trainer rumbling up a field, spouting dust or spray, banking perilously to avoid a power line at the far end, then coming back down at 80 miles per hour, 8 to 15 feet off the ground. Pilots have learned much about the effects of climatic conditions—humidity, air currents, and temperatures, and they know how to time the best applications. However, in using dust especially, an occasional and unexpected "ill wind" will create a hazard by causing the material to drift. As much as 70 or 80 percent of the material, in certain cases, may be lost by drifting off the area being treated. And it sometimes settles where it will do more harm than good. Recent news stories allege a 15-mile damaging drift of 2,4-D spray in the San Joaquin Valley.

Typical spray-planes are small bi-wing types, but with 250 to 400 horsepower engines. These large power plants are necessary because spray rigs fly very low (the general idea being that if the spray does not kill the weeds, they will die from fright), and must be able to lift 100 to 200 gallons of material (800 to 2000 lbs.) suddenly over the power lines, trees, ditch banks, and buildings which often crowd the end of the short runs.

In general, there are about as many types of applicators as there are airplanes applying spray material or dusts. Three of the many types used are shown in the accompanying photos.

One is an ingenious device which uses a spinning wire brush powered by an airdriven fan on the leading edge of the wing. The solution is gravity-fed down a hollow shaft

and is dispersed in droplet size by the propeller slip stream when spun off the brush. The rate of application is valve-controlled, usually at each brush, for instantaneous shutoff is necessary.

The other systems shown are of the "long boom" type, with nozzles spaced at about 12" centers along the boom. In contrast to these, there are many "short boom" types, 6 to 8 feet long, in use. The blast from the airplane propeller and turbulence from the wing tips act as an added disperser to the sprays, also stirring up the air around the plants to the point where a very satisfactory coverage of all surfaces is achieved without the excessive use of spray or high pressures which are necessary with ground equipment sprays in the quiet morning air.

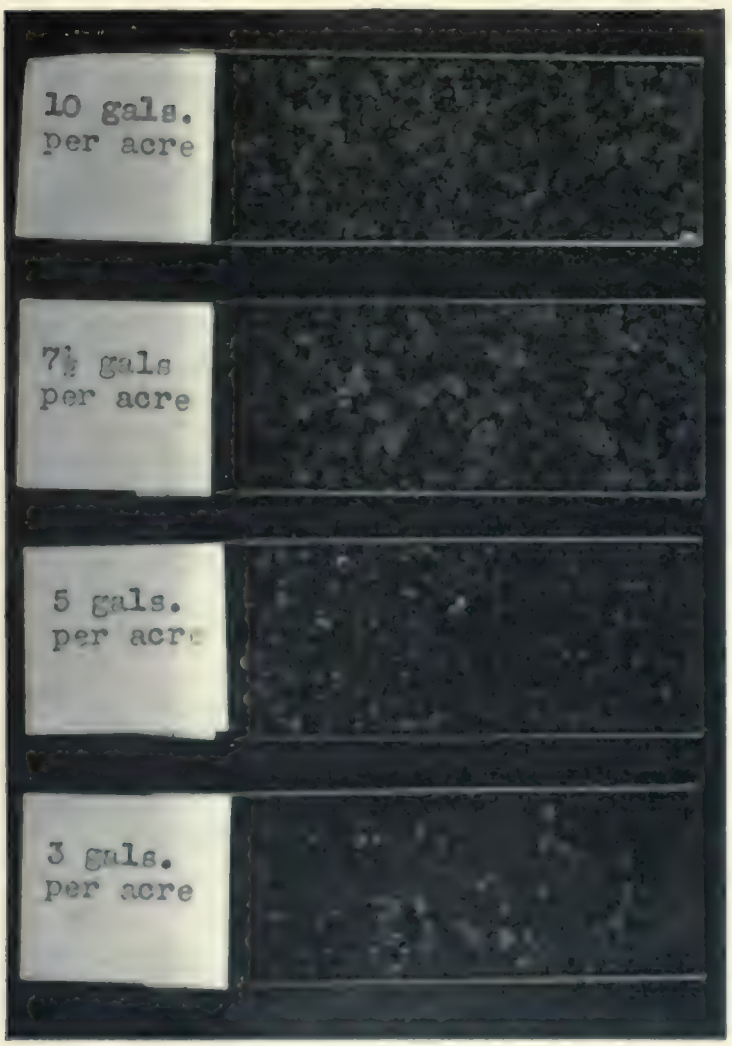
Size of Droplets Important

Droplet size of material sprayed from airplanes is of primary importance. Some materials, such as selective herbicides for controlling weeds in crops, seem to be more effective when applied as coarse sprays. This is fortunate because airplanes must produce droplets larger than those from ground machines to prevent excessive drifting and to prevent evaporation of water-diluted sprays before the desired surface is reached. Insecticides usually give a more uniform and effective deposit when atomized to smaller droplet size.

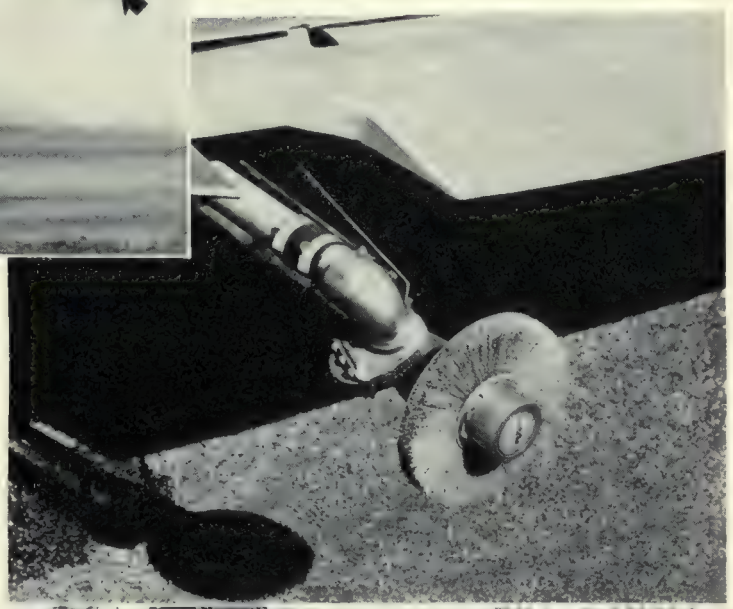
The accompanying photograph shows how the number of spray droplets are determined in field tests. The glass slides, placed in a field at the time of spraying, show the number of droplets per square inch at various rates of material per acre. The minimum effective dosage indicated by the slides for the test was five gallons per acre. The three-gallon application did not give sufficient coverage of spray material.

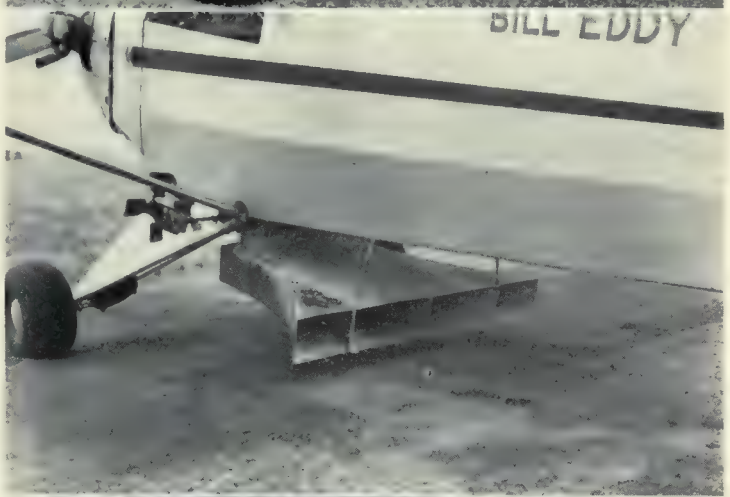
Pressure-developing devices are as numerous as applicator types. There are gravity systems, those powered by air-driven fans mounted between the wheels, some of which are gear-operated off engines. Those powered by air-driven fans are generally considered to be the best. Pressures used vary widely, from a few pounds per square inch to slightly over 100 pounds.

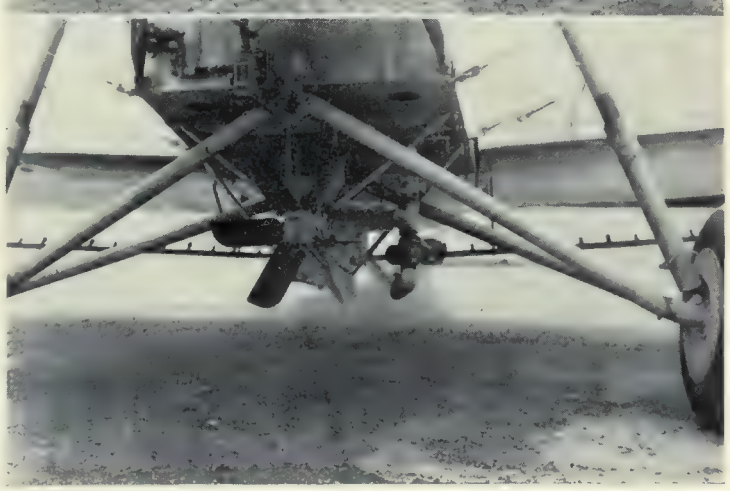
Insect-control was the first farm job undertaken by airplane. Spreading of herbicides for weed control is growing. Selective sprays, primarily 2, 4-D, are those most used. This type of spray is ideally suited for dissemination by airplane because of the low volume of material required—only 2½ to 6 gallons per acre. Airplane dusting, however, is losing favor in California because it is so much more difficult to control drift of dusts than liquid sprays, and progress in the development of sprays that can be applied in low volumes has increased their usability. Use of general contact sprays has been limited because of the relatively high



At left: Slides showing number of 2, 4–D droplets sprayed from plane at different dosage rates per acre. Below: Helicopter lands for refill on mountain meadow, inaccessible to ordinary plane. Bottom photo: Spray hopper on side of helicopter fuselage. *All photos courtesy State of California Department of Agriculture.*







At left: Airplane equipped with brush type spray applicators in operation. Below: Close-up view of brush spray applicator. Below center: Side view of "venturi" type spreader showing outlet of spreader and small square bladed propeller in background which drives dust agitator. At bottom: Front view of airplane equipped for weed control by means of chemical spray. The wind-driven impeller beneath the fuselage is connected to the feed pump. *Two top photos furnished by W. A. Harvey, University of California. Center and bottom photos by A. J. Burrows, Region II.*

volume of oils required per acre. An application of 30 gallons per acre is considered the upper economic limit for most airplane spraying. However, newly developed chemicals needing only 14 to 15 gallons of solution per acre are being successfully used on alfalfa, onions, peas, and other crops to which such selective sprays are suited. Weed control on cropped lands has been so successful that tests are now being made to determine the feasibility of spraying brush-infested range lands. Early results indicate the practice might be quite successful, with costs perhaps no more than $6 per acre.

Costs for airplane spraying are dependent upon several factors, principal of which is volume, or weight. Liquid sprays are applied for about 30 cents a gallon; dusts at 4 to 5 cents a pound. Indeterminate jobs are charged at a rate of about $60 an hour flying time. Other factors that determine spraying costs are distance to airfield or landing strip, size and shape of area to be flown, insurance rates, and any laws or local ordinances that prevail in the area. Keen competition between different companies is also an important factor. Average cost of applying spray to grain fields ranges from $1.25 to $1.50 per acre.

Use of airplanes to speed up and improve farm practices aside from insect and weed control is gaining ground steadily. Rice has been planted by plane for a long time with great success, for the heavy kernels zip right down through the water into the mud beneath with very little wastage. Other grains and grass seeds have been planted from the sky more recently and with less success. Grass seed, in particular, is very difficult because its extreme fineness and light weight make it necessary to mix such inert matter into the hopper just to get the seed to feed economically. The field is wide open for the development of "pelleting" light seeds and seeds that are to be sown in dry ground, to bring this practice to greater efficiency. Some work along this line has been done with tree seeds, in an attempt to reforest large areas, a very expensive process by usual means, but success has been small.

Fertilizing rice paddies from the air is already common practice (see picture). Water-covered rice was a "natural" for this type of operation, and it will probably be not too difficult to extend it to other field crops, but the exact placement of fertilizer necessary for row crops seems to leave them out of the picture.

Aircraft are exceptionally well suited to intercept invasions of grasshoppers, leaf hoppers, and crickets before they reach crop areas. These have been bombed from the air on several occasions with RAF vs. Luftwaffe success.

The most recent and spectacular use of aircraft, of course, has been the series of assaults on potential rain clouds which have made the mistake of tantalizing drought-stricken areas. There is no overwhelming technical reason why this may not be successful in certain places at certain times, but the Bureau of Reclamation is still planning to build dams as a stop-gap measure.

"Aircraft," of course, includes helicopters as well as airplanes. Helicopters more nearly meet the ideal of a machine that can fly very low and very slow. They are much safer than airplanes when operating in small fields bounded by power lines or buildings, and they can confine their spray more nearly to the area they are supposed to cover. The down-wash from the machine's rotor drives the spray into vegetation and at the same time spreads a wider swath. Helicopters can land at the field being treated, thus cutting down the added expense of an airplane's ferrying time.

Even though their original cost is higher, helicopter application of weed control materials is less expensive. By flying slower, there is less drift, and less gallonage is required to cover the same area.

At present, weed and pest control by airplane has proved itself on field crops, on canals, and irrigation ditches. But the very real problems presented by drifting toxic dusts and sprays, often carried upward from the quiet air near the ground into cross currents by the very turbulence which helps so much to spread them over plants, the difficulties and dangers of operations in close quarters, etc., has limited their usefulness in specialty-crop small-farm areas. These are the areas which could use them best. The possibility of thoroughgoing aircraft use would be a great boon to the family-size farm. It would make it unnecessary for the individual farmer to purchase a variety of expensive equipment for special jobs which have to be done in a hurry. With the cost of such work done by aircraft spread over a whole township of small farms, per acre costs would be as low as on the most efficient larger operation.

In fact, the difficult problems listed above have been responsible for the adoption of restrictive ordinances in airplane spraying with certain forms of chemicals. Careless applications have also been responsible for restrictive measures.

As a result of damage to susceptible crops from drifting chemicals in the last 2 or 3 years, the Civil Aeronautics Administrator now prohibits the use of 2,4-D dusts from airplanes. Indications are that there will be further restrictions placed on the use of this and other chemicals that cannot be controlled completely at the present time from airplanes.

This program of stern restriction indicates the need for research. There has been very little accomplished in a coordinated program of research on the problems involved in the use of this most imaginative, yet most practical of farming methods. Most of the drawbacks to these methods have been far outweighed by the substantial advantages of airplane work:

- speed and thus timeliness of application;
- independence of soil surface condition, which often prevents the use of ground equipment at the time when spraying is needed;
- thorough coverage without damage to the plant, possible because the turbulence in the air swishes any mixture around the plant instead of fire-hosing it against foliage and stems;
- complete lack of the mechanical damage to the crop which must always come from even the most careful use of wheeled equipment;
- reduction of labor time and equipment cost.

With further refinements in technique and equipment, wide use of airplanes could certainly save American farmers each year as much as a whole large scale research program would cost.

THE END.

EDITOR'S NOTE: The above article has drawn heavily on the work of O. C. French and F. A. Brooks of the University of California. Mr. French's "Use of the Airplane for Pest Control" (Agricultural Engeering, June 1947) is an excellent over-all descriptive survey. Mr. Brook's "The Drifting of Poisonous Dusts Applied by Airplanes and Land Rigs," in the same issue, is an important report on work which has pretty well defined the best particle size to prevent excessive drifting, and should thus serve as the basis for redesigning many types of dusting rigs now in use.

"VEX" VERDICT

Ole Man River Must Go To Work— By Order of the Court

Here is part of a 1928 court decision rendered by a county judge in Walla Walla County, Wash., ruling against the riparian rights principle. It was sent to the RECLAMATION ERA by Charles Cone, Columbia Basin Commission.

Furthermore, the necessity for, and the benefits accruing from irrigation in the arid West in this utilitarian age have resulted in the abrogation of the Old English view of riparian rights.

The doctrine that a riparian owner was entitled to have the stream flow by his door unvexed and undiminished even though he made no use of the water except to observe its beauty and listen to its babble, has been badly shattered by the materialistic courts of the far West.

Even our own Supreme Court, as sordid and unpoetical as such a doctrine may seem, has adopted the view in late decisions, that water is better employed growing onions and alfalfa than by reflecting the beauty of the moon while singing its way unvexed to the sea. Decision made on May 8, 1928, by E. V. Kuykendall, Superior Judge, County of Walla Walla, in the case of the *State of Washington* v. *Charles Achermann et al.*

The Low-Down on Ground Water

By HARRIS R. McDONALD,

Hydrologic Engineer, Hydrology Division, Branch of Project Planning, Denver, Colo.

GROUND-WATER CONDITIONS VARY in different areas, and there are a few facts about ground water, deep-well irrigation and pumping that are often misunderstood.

For example, I was working on a ground-water investigation down in Arizona a few years ago, in an area where wells are extremely scarce, and I espied a little shack about half a mile off the road. So I drove over there. There was an old man sitting on the steps, and I asked him if he had a well. He says, "No, sir, I don't, but if you are interested in wells, come with me." So he went in the house and came out with a cigar box. He opened the lid, I looked in the box, and saw some Mexican jumping beans. The old man started walking off, and said, "Watch those beans." Pretty soon, he stopped suddenly, made a mark on the ground with his foot and said, "See those beans. They're jumping like all get out." And they were, too. They were really jumping around in there. He said, "Mister, we're standing over a pool of oil." Well, I didn't get the connection between the beans jumping and the pool of oil, but it was useless to try to convince him that his chances of getting oil there were pretty slim.

This illustrates the superstition that is commonly associated with phenomena that are not understood by the observer. There are several thousand dollars spent each year trying to locate water in similar fashions. For instance, the willow twig, called a "witching stick." Those who use it are called "water witchers." One is supposed to hold it in a certain manner, and of course, it always helps if you can assume a stance that looks as if you are communicating with a supernatural power. The supposition is that you walk around, and when you get over a vein of water the twig is supposed to dip down. The only trouble with this method is that when I hold it, the twig always pops up and hits me in the face. Of course, it is only a twig, and it has no knowledge of where the water is. I don't mean to infer that everyone who uses these sticks are intentional deceivers, but I do think that a large group of professional water witchers are deliberately defrauding the public. Back in the sixteenth and seventeenth centuries this stick was used to locate not only water, but gold and silver and other valuable minerals.

Let us not confuse these tricks with the modern methods of geophysical prospecting. In connection with the search for oil deposits, a number of different geophysical methods have been developed that are based on scientific facts. Perhaps you have heard of the magnetic airborne detector, that was developed by the Navy and the Geological Survey durthe war to locate enemy submarines. This instrument operates on the principle that different geological formations, will affect the magnetic intensity of the earth. This instrument is carried on the end of a cable which is attached to an airplane. The airplane is flown at a constant altitude above ground level with the aid of a radar altimeter, and the automatic recording instruments inside the plane record the changes in magnetic intensity as this instrument is carried over the earth. A while back we made a survey of 240 square miles with that instrument in about two hours. By ground methods that would have taken about 140 days, and the cost would have been much greater.

Now there is an old saying that you never miss the water until the well runs dry. I think that statement is probably more true today than ever before, not only with individual wells but with the great underground reservoirs which constitute our ground-water resources. The requirements for water of the early settlers in the arid and semiarid regions of the West were confined largely to domestic and stock-water supplies. There was no question of legal rights or quantitative supply involved. But as we started to irrigate and use the surface run-off from our streams, there came a time when there wasn't enough water to go around, and some enterprising farmer dug a well, put in a pump, and started to irrigate. That was so successful that now almost every State in the West has some irrigation.

Ground water is adapted to municipal and industrial uses, particularly. The bacteria content of the ground water is usually low enough that it requires no treatment for human consumption. Another reason that ground water is adapted for these purposes is its constant temperature. Certain industries such as distilleries require cool water for condensing purposes. During the war the alcohol distilleries in Louisville, Ky., were used to manufacture alcohol for making synthetic rubber, and they had been pumping so much water there that they had depleted their ground water reservoir. An investigation there resulted in the diversion of treated surface water in the wintertime into the same wells from which water was pumped in the summertime for condensing purposes. That is, the temperature of the surface water in the summertime was so high that it couldn't be used for condensing purposes.

We realized then, with increased use of ground water, that our supply was limited and that the amount could be used only as it was replenished. This has led to ground water laws in a number of our Western States, including New Mexico, Utah, Washington, and Arizona. Several of

our Western States have ground water laws which limit pumping in areas where the supply is not sufficient for the demand.

Another thing about ground water that is often misunderstood is the rate of movement. The velocity of ground water may be determined in a number of ways—sometimes by using salt, or dyes like Fluorscein. If you drop a speck of Fluorscein about as big as a pinhead into a glass of water it will fluoresce. If you let the ultraviolet light strike that for a while and bring it into a dark room, it will glow. It is practically impossible to remove this dye by filtering and it can be recognized in a solution of one part dye to ten billion parts of water. Another method of determining velocity is by pumping tests. By pumping tests we can determine the physical characteristics of the water-bearing material and compute the velocity. The average velocity found in nature is around 2 or 3 feet a day. Of course, there are exceptions such as cavernous limestone, fractured rock, or very coarse gravel, where velocities might run higher than that.

There was once a man who had a dug well, and said, "I struck my water in this well at 8 feet, and the water is flowing from the east side over to the west side." When asked how he knew it was moving that way, he replied, "When leaves fall down in there, they all collect over on the west side." He may have been right, but I suspect that the movements of air had more to do with the movement of those leaves than the movement of the water did.

You all may have heard the statement, "my water is 99 percent pure." From the standpoint of mineral solids, purity of water is usually stated in parts per million, and if water were 99 percent pure, that would mean it contained 1 percent of impurities. One percent of a million is 10,000, and no one would want to drink water that contained 10,000 parts per million of, for example, common table salt. And, of course, the same thing holds true from the bacteriological standpoint.

Here are a few practical points about well drilling and pumping. The first thing a person wants to know, of course, is where to drill a well. The best source of information is a reliable local well driller. These fellows have built up a great backlog of experience. They are familiar with the water-bearing formations, and very often they can tell you whether your chances are good or not of getting a good well in the area. Of course, nobody can be sure, but if he indicates that the chances are not very good that you will get a good well there, then it might be well to ask your county agent if there are any water supply bulletins out for that area. Sometimes these are very helpful.

Now there are two commonly used methods of drilling wells—cable tools and rotary. Cable tools are, just as the name implies, tools on the end of a cable, and I'm sure you have all seen wells drilled by that method. Every driller has his preference. Usually in shallow wells, they'll use a cable tool rig if they have one handy, because it is quicker to set up. In rotary drilling, the mud is circulated through the hollow drill stem, pumped down into the ground, and it brings up the drill cuttings. Then the heavy drill cuttings are allowed to settle out, and the mud is recirculated. In rotary drilling the casing usually is not put in until the drill hole is finished. That is one of the advantages of rotary, and it's fairly rapid unless you get loose boulders or something else that slows you up.

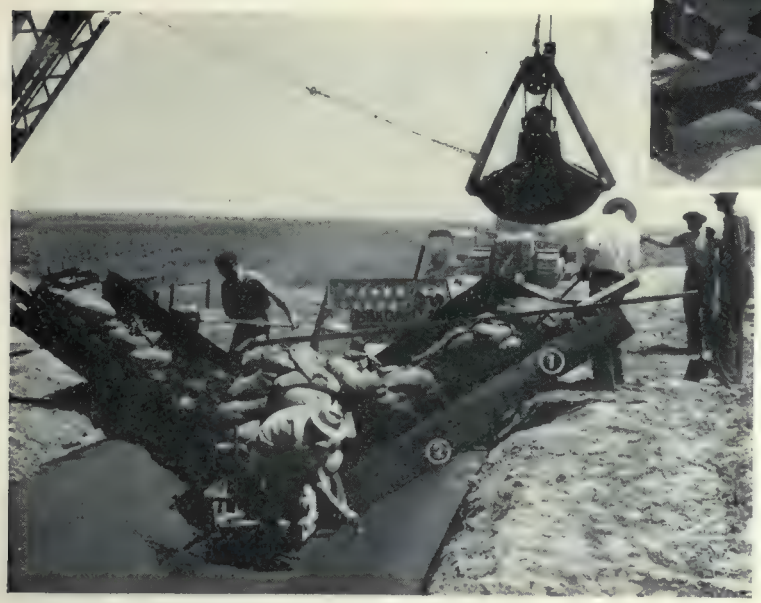
Many drillers will take great care in drilling a well, but they will pay very little attention to the development of it, but well development is just as important as well drilling. You might have a good hole, but if you cannot get water out of it, it is not of much use to anyone. Well development means the formation of a natural or artificial gravel pack around the screen or casing. Obviously, you have to remove the fine particles in the gravel surrounding the screen before

(Continued on page 242)

Left: Underground water irrigation pump, powered by natural gas, is located northeast of Goodland, Kans. Above: Darrel Bower, Ainsworth, Nebr., watching irrigation pump (note power source). Water is used to irrigate corn.

Asphalt Linings for Irrigation Canals

By HARRY M. SULT,
General Engineer, Office of Programs and Finance, Washington, D. C.



Above: Inside the asphalt lining machine, showing operators guiding the asphalt mix into the pan below the strike-off blades (1). The cable (2) is also shown. At left: In the wake of the paver, showing the other side of the screeds, or strike-off blades (1), and the hot irons (2) used to give a surface seal. *Both photos by A. F. Swanson, Columbia Basin project.*

ASPHALTIC CONCRETE—the material which paves many of America's highways—may some day play a very important part in the future irrigation development of the West.

For a number of years the Bureau of Reclamation has been experimenting with various materials in a search for a dependable, durable and low-cost canal lining for the many hundreds of miles of unlined canals in the West. About 20 percent of the irrigation water which flows through these unlined canals is lost through seepage. That much water is worth saving, and bituminous materials are among those which are being given on-the-job tests in water conservation.

The potentialities of bituminous materials were fully appreciated when the Bureau recently completed a large canal construction project on the Pasco lateral system of the Columbia Basin project in Washington. This was in reality a gigantic large scale laboratory where several different types of lining were installed for the purpose of obtaining comparative data on efficiency, durability and cost under climatic conditions encountered in that area.

Much of the work involved placing about 86,000 square yards of 2-inch thick asphaltic concrete lining very similar in design, mix and placing to that used for asphaltic concrete highways.

Although a variety of bituminous linings have been under study during recent years, the five major types are as follows:

1. Linings constructed by mixing, either hot or cold, as in highway construction.
2. Bituminous membranes sprayed onto the canal subgrade.
3. Bituminous membranes sprayed on the subgrade and covered with about 18 inches of earth.
4. Prefabricated linings of asphaltic mixes on various mineral or vegetable fabrics.
5. Pneumatically applied asphalt.

Of all these, the hot mix lining is believed to offer the best possibilities. When properly designed and installed it is relatively impermeable, is resistant to cracking, offers low resistance to the flow of water and is resistant to mechanical injury by animals, erosion or canal cleaning equipment—all desirable characteristics in a canal lining. Perhaps of greater importance, it is adaptable to highly mechanized methods.

Asphaltic concrete linings are now being designed for workability of the mix, impermeability of the compacted material, resistance to weed growth and water action, and necessary strength to withstand slope pressures.

Just as in asphaltic concrete highway construction, the workability of the mix is particularly important in canal construction, as the density and strength of the finished product depends upon this characteristic. In turn, the permeability of an asphaltic concrete slab depends upon the density of the compacted material. Workability is of double importance in canal construction which requires more difficult and complex handling and placing operations than those involved in paving a flat surface.

Present practices indicate that a well-graded aggregate not exceeding three-quarter inch maximum size, but graded to fine rather than coarse, will permit a mix having the necessary workability. Adjustments of the mix during actual operations are usually required to achieve and maintain the optimum workability.

To be economically justifiable, any canal lining should have relative impermeability to water. Laboratory tests have indicated that an asphaltic concrete lining with proper design of the mix for workability, and with sufficient compaction to reduce the air voids in the compacted lining to less than 5 percent, will approach this standard. Such a high degree of compaction has been extremely difficult to achieve, and it has been the practice to apply a surface seal of asphaltic material to increase the impermeability of the lining. However, it has been found that in general such a surface seal reduces the resistance of the lining to a particular form of erosion which results from the drying and curling of the silt layer which usually forms on a canal surface. The curling of this mud film lifts and displaces the top layer of the lining.

Another factor that is important in the design of asphaltic mixes for canal lining is the resistance of the mix to what is called "stripping" action, in which the asphalt material is displaced from the aggregate itself. Where laboratory tests show possibilities of stripping, a new source of aggregates should be located or a commercially available anti-stripping agent should be employed in the mix.

Weeds Menace Asphalt

One of the greatest drawbacks to the extended use of asphaltic canal linings is their susceptibility to damage by weeds. A great variety of weeds, when germinated under an asphaltic surface, are fully capable of penetrating two inches of normally designed asphaltic concrete material. While the resistance of canal linings to this form of damage can be increased through the use of harder asphaltic cements, greater compaction, leaner mixes, and very dense aggregate gradation, sterilization of the subgrade is generally the only answer.

A number of different materials, such as sodium chlorate, borax and other borates, boric acids and other compounds of borans have been employed for soil sterilization but have not proven entirely satisfactory over a relatively long period of time. At present, experiments are being made with various compounds which are formed through the catalytic cracking of petroleum products, and these materials appear to offer considerable promise of providing a satisfactory solution to this problem.

Field experience has proven that a 1½ to 1 side slope is the steepest that should be employed, if sagging or flow of the asphaltic lining is to be avoided. Also, to prevent or minimize "heaving" or "blow-outs" at the junction of the side slopes and the base slab, the canal cross-section should be designed with a curved transition surface between the sides and the base. Present Bureau of Reclamation practices require an 18-inch radius at this point with a larger radius favored where possible.

The construction on the Pasco Lateral System was outstanding not only because it constituted a large outdoor laboratory for comparative studies on several types of linings under actual field conditions but also because a concerted effort was made to develop and use efficient mechanized equipment, particularly with respect to the asphaltic concrete lining. Specifications called for spreading, shaping and compacting the asphaltic concrete with a power-operated machine capable of producing a lining meeting the requirements.

The contractors used more or less conventional equipment for excavating and trimming the canal section and installing both the concrete and pneumatically applied mortar linings. However, they used a radically new machine for placing the asphaltic concrete lining. After making several field alterations and improvements, they were able to produce a lining which more than met the specification requirements.

This lining machine, called a "Canal Paver," was made to order for this job by an iron work company located at Huntington Park, Calif., and was designed so that the entire cross section of the canal could be paved in one operation.

Basically, the canal paver consisted of a large guide sled or "pan" with vertical strike-off blades attached to the rear. The guide pan, shaped to fit the canal cross section, rode upon the trimmed subgrade and furnished the necessary stability for placing a lining of uniform thickness. The strike-off blades, also in the shape of the canal cross section, were attached to the guide pan by means of iron beams which left an open area between the blades and the pan where the asphaltic mix could be dumped directly upon the subgrade ahead of the blades.

Hot screeds, heated by butane gas, rode directly in back of the strike-off blades, to which they were attached. At first, the machine was equipped with rollers, also attached to the strike-off blades, to compact the lining. A gasoline motor-powered winch, mounted on the guide pan, pulled the machine forward by means of a cable anchored to a deadman ahead of the machine.

Later on, the contractors decided to remove the rollers, which were scuffing and marking the lining. In addition, a flat plate was welded between the leading edge of the hot screeds and the leading edge of the strike-off blades, resulting in a short slipform. The hot screeds were then loaded with sand bags to obtain the necessary compaction. These alterations were both gratifying and startling, resulting in so dense and well finished a lining that Bureau engineers decided it was no longer necessary to apply a seal coat, except in localized areas where the lining was scuffed or damaged, and therefore this requirement was eliminated.

Another elimination was that of permanently sterilizing the subgrade—generally considered essential to the success of an asphaltic lining. This operation was omitted, in all but a few areas, because of the rather sterile soil encountered in the Pasco area, and the relatively high cost of sterilization. The exceptions which were made involved a few short lengths where the subgrade was sterilized to permit making com-

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Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION
WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation
Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management*, G. S. Ellsworth; *Chief Counsel*, Clifford E. Fix; *Chief Information Officer*, Leonard W. Mosby; *Chief Personnel Officer*, Glenn D. Thompson; *Director, Programs and Finance*, Alfred R. Golze; *Director, Branch of Operation and Maintenance*, Goodrich W. Lineweaver; *Director, Branch of Power Utilization*, Harvey F. McPhail; *Director, Branch of Project Planning*, John W. Dixon; *Comptroller*, William F. Kubach; *Director of Supply*, S. W. Crosthwait

Denver Staff Offices of the Commissioner: United States Department of the Interior, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Chief Engineer and Director, Branch of Design and Construction, L. N. McClellan; *Chief, Legal Division (Office of the Chief Counsel)*, Robert B. Starke; *Chief, Hydrology Division (Branch of Project Planning)*, John R. Riter; *Chief, Power Field Division (Branch of Power Utilization)*, E. C. Schurch; *Chief, Denver Finance Division (Office of the Director of Programs and Finance)*, Archie M. Rankin; *Associate Director of Supply (Office of the Director of Supply)*, J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller)*, Wendell Bramwell; *Chief, Personnel Field Office (Office of the Chief Personnel Officer)*, Everett K. Gould; *Head Field Service Section, Administrative Release Division (Office of Management Planning)*, Mrs. Catherine Coon

Alaskan Investigations Office, Juneau, Alaska, Joseph M. Morgan, Chief

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, H. T. Nelson; *Regional Engineer (Branch of Design and Construction)*, Grant P. Gordon; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, W. H. Tuller; *Regional Power Manager (Branch of Power Utilization)*, Don S. Campbell; *Regional Planning Engineer (Branch of Project Planning)*, E. N. Torbert; *Regional Programs and Finance Officer (Programs and Finance Division)*, A. W. Empie; *Regional Information Officer (Information Division)*, H. C. Blonk; *Regional Land Officer (Land Acquisition Division)*, W. B. Wallace; *Regional Counsel (Legal Division)*, H. R. Stinson; *Regional Personnel Officer (Personnel Division)*, V. L. Rushfeldt; *Regional Supply Officer (Supply Division)*, James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Anderson Ranch Dam	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Payette Pump unit construction office	R. W. Adams	Construction engineer	P. O. Box 172, Caldwell, Idaho.
Cascade Dam construction office	Earl Harmon	do	P. O. Box 440, Cascade, Idaho.
Payette division O. & M. office	Theodore Nelson	Irrigation manager	Notus, Idaho.
Owyhee project O. & M. office	J. F. Spofford	do	Nyssa, Oreg.
Vale project O. & M. office	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	P. O. Box 368, Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes project	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hungry Horse project	C. H. Spencer	do	Columbia Falls, Mont.
Lewiston Orchards project	Wilred L. Karrer	do	Weisberger Bldg., 5th and Main, Post Office Box 621, Lewiston, Idaho.
Minidoka project	S. R. Marean	Superintendent	1359 Palisades, Idaho, Mail Address: Hansen Ave., Burley, Idaho.
Palisades project	I. Donald Jerman	Project engineer	Palisades, Idaho, Mail Address: Post Office Box 1259, Idaho Falls, Idaho.
Yakima project	O. W. Lindgren	Superintendent	P. O. Box 1377, Federal Bldg., Yakima, Wash.
Planning Offices and Independent Field Stations			
Kalispell planning office	Charles S. Hazen	Planning engineer	Ford Bldg., Post Office Box 97, Kalispell, Mont.
Salem planning office	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla planning office	M. Boyd Austin	do	Bldg. T-208, Walla Walla City-County Airport, Post Office. Box 718, Walla Walla, Wash.
Rathdrum Prairie project, Post Falls unit, independent field station.	E. A. Lavonture	Watermaster	Route 2, Post Falls, Idaho.
Missoula Valley project, Big Flat unit, independent field station.	Pierre J. LaCasse	do	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Umatilla project, independent field station	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director*, R. S. Calland; *Assistant Regional Director*, Phil Dickinson; *Assistant to the Regional Director*, U. J. Gendron; *Regional Engineer (Branch of Design and Construction)*, A. R. McGinness; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, J. G. Lindley; *Regional Power Manager (Branch of Power Utilization)*, B. W. Crelm; *Regional Planning Engineer (Branch of Project Planning)*, S. A. Kerr; *Regional Programs and Finance Officer (Programs and Finance Division)*, T. K. Vasey; *Chief, Land and Right of Way Division*, Joe H. Leech; *Regional Information Officer (Information Division)*, Max Stern; *Regional Counsel (Legal Division)*, L. O. Graham; *Regional Personnel Officer (Personnel Division)*, H. F. Osborne; *Regional Supply Officer (Supply Division)*, H. F. Halliday

	Official in charge		Address
	Name	Title	
District and Project Offices			
Delta district	C. H. Kadie, Jr	District manager	Post Office Box 1407, Sacramento 10, Calif.
	O. G. Boden	Construction engineer	Antioch, Calif.
	H. W. Thomson	do	Elverta, Calif.
Klamath project	E. L. Stephens	Project manager	Post Office Box 312, Klamath Falls, Oreg.
Sacramento Valley district	James K. Carr	District manager	Post Office Box 302, Chico, Calif.
	William J. McCrystal	Construction engineer	Redding, Calif.
Santa Barbara project	E. R. Crocker	Project manager	Post Office Box 701, Goleta, Calif.
Tulare Basin district	J. W. Rodner	District manager	406 Patterson Bldg., Fresno, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer (Branch of Design and Construction)*, C. A. Bissell; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, A. B. West; *Regional Power Manager (Branch of Power Utilization)*, R. V. Sprague; *Regional Planning Engineer, (Branch of Project Planning)*, E. G. Nielsen; *Regional Programs and Finance Officer (Programs and Finance Division)*, M. E. Rains; *Regional Counsel (Legal Division, 458 S. Spring St., Los Angeles, Calif.)*, R. J. Coffey; *Regional Supply Officer (Supply Division)*, O. J. Littler; *Regional Personnel Officer (Personnel Division)*, M. H. Mitchell; *Chief, Programs Section, (Programs and Finance Division)*, D. A. Dedel; *Chief, Office of River Control*, C. P. Vetter.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
Gila (Construction)	Murray J. Miller	Construction engineer	Do.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
All American Canal (Coachella division)	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	Post Office Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	Project engineer	Parker Dam, Calif.
San Diego	R. E. Burnett	Engineer	Escondido, Calif.
Project Planning Officers and Design Units			
Escondido planning office	R. E. Burnett	do	Post Office Box, 357, 414 West 3d St., Escondido, Calif.
Overton planning office	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix planning office	V. E. Larson	Assistant regional planning engineer	337 West Washington, Phoenix, Ariz.
St. George planning office	J. D. McCoy	Engineer	Post Office Box 606, 53 N. Main St., St. George, Utah.
Davis Dam design unit	H. I. Fitz	Head, design unit	Box 1809, Aviola Radio Corp. Bldg., Phoenix, Ariz.
Davis transmission system design unit	A. J. Ecker	do	Do.
Coachella design unit	H. R. Voris	do	360 South San Gorgonio Ave., Banning, Calif.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant Regional Director*, C. D. Woods; *Regional Engineer (Branch of Design and Construction)*, C. H. Carter; *Regional O. M. Supervisor (Branch of Operation and Maintenance)*, D. S. Stuver; *Chief, Resources and Development (Branch of Power Utilization)*, L. E. Mathews; *Regional Planning Engineer (Branch of Project Planning)*, Reid Jerman; *Regional Programs and Finance Officer (Programs and Finance Division)*, F. J. Farrell; *Acting Personnel Officer (Personnel Division)*, G. A. McDougal; *Regional Counsel (Legal Division)*, J. S. McMaster; *Acting Regional Supply Officer (Supply Division)* E. G. Bywater.

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Paonia	R. W. Jennings	do	Post Office Box 623, Paonia, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area Field Offices			
Fallon	W. H. Slattery	do	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Hedderman	do	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 780, Grand Junction, Colo.
Kemmerer	P. B. Delong	do	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	do	46 East Center, Post Office 294, Logan, Utah.
Salt Lake City	F. M. Warnick	Acting area engineer	211 Federal Bldg., Post Office Box 360, Salt Lake City 8, Utah.
Spanish Fork	P. R. Neeley	Area engineer	Post Office Box 71, 24 N. Main, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.

Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Regional Engineer (Branch of Design and Construction)*, O. I. Craft; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, R. S. Bristol; *Regional Power Manager (Branch of Power Utilization)*, A. H. Sullivan; *Regional Planning Engineer (Branch of Project Planning)*, Rex E. Reed, *Assistant Regional Programs and Finance Officer (Programs and Finance Division)*, C. L. Harris; *Regional Counsel (Legal Division)*, S. L. Baird; *Regional Personnel Officer (Personnel Division)*, H. F. Kirby; *Regional Supply Officer (Supply Division)*, I. G. Campbell; *Regional Safety Adviser*, G. F. Peterson.

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	J. A. Callan	Project engineer	Altus, Okla.
Balmorhea	Paul Powell	Irrigation maintenance superintendent	Balmorhea, Tex.
Carlsbad	H. H. Kidder	Project superintendent	Carlsbad, N. Mex.
Rio Grande	L. R. Flock	Project manager	U. S. Courthouse, El Paso, Tex.
Elephant Butte Power & Storage	Labon Backer	Division superintendent and actg. constr. engineer.	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta	F. D. Postle	do	Ysleta, Tex.
San Luis Valley	W. H. Sweet	Acting project engineer	117 Jefferson St., Monte Vista, Colo.
Platoro Dam	Ernest Puckett	Construction engineer	Tucumcari, N. Mex.
Tucumcari	R. J. Lyman	do	Do.
	W. B. Pierce	Acting construction engineer	Do.
Valley Gravity	John C. Thompson	Project engineer	McAllen, Tex.
Project Planning Offices			
Albuquerque	J. L. Mutz	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	H. P. Burleigh	do	Post Office Box 817, Littlefield Bldg., Austin, Tex.
Oklahoma City	M. G. Barclay	do	Post Office Box 496, 516 Oklahoma National Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Yale Building, Post Office Box 2130, Billings, Mont.

Regional Director, Kenneth F. Vernon; *Assistant Regional Director*, W. E. Rawlings; *Assistant to the Regional Director*, George O. Pratt; *Regional Engineer* (*Branch of Design and Construction*), C. G. Anderson; *Regional Supervisor* (*Branch of Operation and Maintenance*), E. F. Landerholm; *Regional Power Manager* (*Branch of Power Utilization*), J. R. Walker; *Acting Regional Planning Engineer* (*Branch of Project Planning*), C. T. Judah; *Regional Programs and Finance Officer* (*Programs and Finance Division*), Duncan Mills; *Regional Land Officer* (*Land Acquisition Division*), W. N. McCormick; *Regional Counsel* (*Legal Division*), W. J. Burke; *Chairman, Interior Missouri Basin Field Committee*, W. G. Sloan; *Chief Reports Coordination Division*, Edwin E. Wilson; *Regional Personnel Officer* (*Personnel Division*), Howard M. Watts; *Regional Supply Officer* (*Supply Division*), Fred W. Gilbert; *Safety Engineer* (*Safety Division*), Charles C. Parsons; *Chief, Municipal Water Supply Investigations Unit*, Stanton J. Ware.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Yellowstone district	Donald C. Ketcham	District manager	Box 1264, Billings, Mont.
Fort Peck	Allen Mattison	Construction engineer	Box 1245, Fort Peck, Mont.
Yellowstone pumping unit	R. B. Kuebler	Engineer	Box 720, Miles City, Mont.
Hardin unit	R. F. Herdman	Construction engineer	Box 516, Hardin, Mont.
Moorehead Dam	W. N. Sanford	Acting construction engineer	Sheriden, Wyo.
Upper Missouri district	Harold E. Aldrich	Acting district manager	Box 1629, Great Falls, Mont.
Milk River	Bruce E. Garlinghouse	Acting superintendent	Malta, Mont.
Canyon Ferry	William P. Price, Jr.	Construction engineer	Box 517, Helena, Mont.
Sun River	C. L. Bailey	Superintendent	Fairfield, Mont.
Big Horn district	R. H. Workinger	District manager	Box 839, Cody, Wyo.
Shoshone-Heart Mountain	W. F. Kemp	Acting project engineer	Box 900, Cody, Wyo.
Boysen and Owl Creek	R. S. Lieurance	Project engineer	Box 1111, Thermopolis, Wyo.
Riverton	T. A. Clark	do	Riverton Wyo.
Missouri Souris district	Bruce Johnson	Acting district manager	Box 1050, Bismarck, N. Dak.
Missouri Souris	G. J. Cheney	Engineer	Box 1869, Minot, N. Dak.
Cannonball Dam	Floyd Jensen	Construction engineer	Elgin, N. Dak.
Dickinson Dam	W. W. Brenner	do	Glen Ullin, N. Dak.
Heart Butte Dam	do	do	Do.
Missouri Oahe District	Joseph W. Grimes	Acting district manager	Box 825, Huron, S. Dak.
Angostura and Rapid Valley	H. V. Hubbell	Project engineer	Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Newell, S. Dak.
Bixby Dam	H. M. Crowell	Construction engineer	Faith, S. Dak.
Keyhole Dam	F. W. Goehring	do	Box 278, Moorcroft, Wyo.
Shadehill Dam	D. M. Forester	do	Box 298, Lemmon, S. Dak.

REGION VII: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director, W.* E. Blomgren; *Regional Engineer* (*Branch of Design and Construction*), Herbert E. Prater; *O. & M. Supervisor* (*Branch of Operation and Maintenance*), John N. Spencer; *Power Manager* (*Branch of Power Utilization*), Harold R. Lee; *Planning Engineer* (*Branch of Project Planning*), John A. Kelmig; *Acting Regional Programs and Finance Officer* (*Programs and Finance Division*), Harry M. Kent; *Land Officer* (*Land Acquisition Division*), Mark W. Radcliffe; *Regional Counsel* (*Legal Division*), Clarence Eynon; *Personnel Officer* (*Personnel Division*), Albert R. Novak; *Supply Officer* (*Supply Division*), William F. Sha; *Administrative Officer* (*Administrative Division*), *H. S. Varner, Jr.; Safety Engineer* (*Safety Division*), *Alton T. Cromwell.*

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Glendo	Murel M. Starr	Construction engineer	Glendo, Wyo.
Kortes	C. S. Rippon	do	Casper, Wyo.
South Platte River district	E. S. Huntington	District manager	Building 11, Denver Federal Center.
Colorado-Big Thompson	Vacancy	do	Estes Park, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Fort Collins	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	C. E. Klingensmith	do	Loveland, Colo.
Narrows Dam	Charles Seger	Construction engineer	Fort Morgan, Colo.
Kansas River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Bostwick Unit	Paul E. Strouse	Construction engineer	Superior, Nebr.
Enders Dam	U. V. Engstrom	do	Imperial, Nebr.
Medicine Creek	Clifford L. Mutch	do	P. O. Box 157, Cambridge, Nebr.
Cambridge Diversion Dam and Cambridge Canal.	C. M. Jackson	do	Do.
Cedar Bluff	R. J. Walter, Jr.	do	Ellis, Kans.
Culbertson Dam	Ellis L. Armstrong	do	Trenton, Nebr.
Bonny Dam	Wayne S. Byrne	do	St. Francis, Kans.
Indianola	H. E. Robinson	District manager	McCook, Nebr.
Do	E. T. Bradford	do	Do.
Niobrara River area	C. E. Burdick	Area engineer	Ainsworth, Nebr.
Mirage Flats project	Fred Krauss	Construction superintendent	Hay Springs, Nebr.
Grand Island Area	P. L. Harley	Area engineer	Grand Island, Nebr.
Upper Arkansas River Area	B. F. Powell	do	Box 515, Pueblo, Colo.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont.	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	W. J. Farrell	Boise, Idaho.
Boise (Payette division, Notus unit)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	O. E. Anderson	Superintendent.	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	do	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	William Griffith	Cory, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo	Carl Hicks	do	C. J. McCormick	Grand Junction, Colo.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo	J. J. Flanagan	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	do	W. A. Long	do	W. E. Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Robert S. Leighton	Secretary-manager.	John Holmstrom	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont.	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Lavor J. Hatch	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Districts 1 and 2	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mr. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	R. Willis Walker	Rexburg, Idaho.
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	Supreintendent.	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hilbel	do	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	Jesse D. Barker	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	G. D. Cardon	Ogden, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	O. L. Norman	Manager	J. F. Griswold	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Rudolph Hope	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo Clark	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	Chester Taylor	Manager	E. S. Yoakum	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	Ed Nunn	do	P. B. Smith	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	O. L. Sterling	do	O. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	David C. Brooks	do	Pauline Osterhout	Sunnyside, Wash.
Yakima (Tieton division)	Yakima-Tieton irrigation district	Yakima, Wash	Guy Finley	Manager	Guy Finley	Yakima, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1940

Reclamation Rain

By CHARLES R. MAIERHOFER,

Acting Chief, Drainage Division, Branch of Design and Construction, Denver, Colo.

The Bureau of Reclamation has kept its eye on recent developments in rainmaking, but so far it has not seen fit to supplant nature's way of relieving thirsty lands. Neither does the Bureau, by producing rain artificially, expect to be able to substitute an airplane and dry ice for canals and reservoirs.

There have recently been circumstances, however, where artificial rainstorms were necessary in order to solve a fundamental drainage problem. This occurred on the Bureau's big Valley Gravity project in the semitropical southern tip of Texas. It seemed unlikely to us that nature would cooperate to the extent of delivering a storm of the proper magnitude even in the length of time required for a Reclamation engineer with four children, pets, and a mother-in-law, to rent a six-room house for $25—this is dry country! When we water lawns and wash cars the city water pressure drops from 55 to 15 pounds p. s. i. (pounds per square inch) and we have to call on Mexico, just across the Rio Grande, for water out of its reservoirs.

This is the land of mañana, and for many things we just have to wait until they happen, but not on this problem. Unreasonable as it may seem, we had to find a quicker way to get the answer than to wait 10 years for a storm, living off the taxpayers in the meantime. Seriously, we were as anxious as the next man to get the answer, because it was urgently needed for project cost estimates—and this is no climate in which to spend 10 years waiting. (Summers last 9 months; the other 3 we wear neckties.)

At this point, a summary of conditions leading to this urgent need for the storm might be worth while.

The major consideration with respect to the drainage phases of the project is a comprehensive system of outlet drains. During the 50 years that project lands have been irrigated, a high water table and the increasing salt content within the root zone which usually accompanies it, have taken over hundreds of thousands of acres of once fine lands and rendered them almost unproductive of the high value crops to which they were once so well adapted. To reclaim and protect such lands requires, among other things, many ditches to lead the saline groundwaters out of the soil and eastward to the Gulf of Mexico. It wouldn't require a very large ditch to carry this subsurface water but, whether we like it or not, when it rains these ditches are called on to carry stormwaters also, brought them by lateral and farm drains from about 1,000,000 acres of land. When it does rain, it is really a good one. A 10-year storm, or storm which can be expected to occur on an average of once every 10 years, is about 6 inches in 12 hours and a great part of it falls in the first few hours. Of course, all of this water doesn't find its way into the drains immediately. If it did the problem would be simple. The drains would have to be so large that they would be economically infeasible to build, and the Bureau would not be able to build them. What happens when it rains is that some water infiltrates into the soil, some evaporates, and a good slug of it runs down hill. This part of the rainstorm that doesn't go into the soil, but runs overland to the nearest ditch is the portion that made us lose sleep. We simply didn't know how much of it there would be to cause flood damage downstream if we built the drains too small.

Infiltrometer in operation. Nozzle hoods are raised, permitting "rain" to fall on the plot, but the run-off has not started. Rainfall intensity is 3.46 inches per hour. Calibration pan in the background. Ends of tent open to permit photo.

Anyone who has had to design a drainage ditch knows that existing formulas for determining storm run-off are a dime a dozen and each gives a different answer. The problem here, then, was to predict accurately the amount of run-off to be expected from a storm of a given magnitude. A guess or formula used in other areas just wouldn't do, because if the system were built too large the cost would be prohibitive, and if too small, flood damage might be tremendous and we'd have the property owners on our necks.

After considerable scratching of heads we got in a huddle with the high I. Q. boys from Denver and the Regional Office and came out with the conclusion that we must create our own storm. To further complicate matters, local soils are so variable that just one storm wouldn't do the job. There had to be over fifty storms! The obvious answer, then, was a rainmaking machine which could be moved around over the different soil types and one with which we could conjure up any kind of a storm at will, even to the tropical hurricanes which sometimes visit us. We tried the nearest hardware store but they didn't have such a gadget handy, due to the steel strike; so, after more discussion and further unsuccessful attempts to find one by the red tape method of borrowing from another Government agency, which didn't have

one anyway, but didn't know it at the time, the Boss put the squeeze on and said we'd have to build one. Well, most of us knew as much about building a rainmaker as we did about putting a porcelain filling in a 5-year molar.

We dug around in the literature for a while and found that some similar work had been done before, but that it wasn't too successful. However, the precedent was there, so we felt justified in going ahead with it. After getting all the information we could on the thing, such as drawings of the equipment others had used, methods of running the test, and such, we got together with the Master Mechanic in the W. C. Austin project's shops at Altus, Okla., and started the job of building the Bureau's first infiltrometer, as those excerpts from a plumber's nightmare are called.

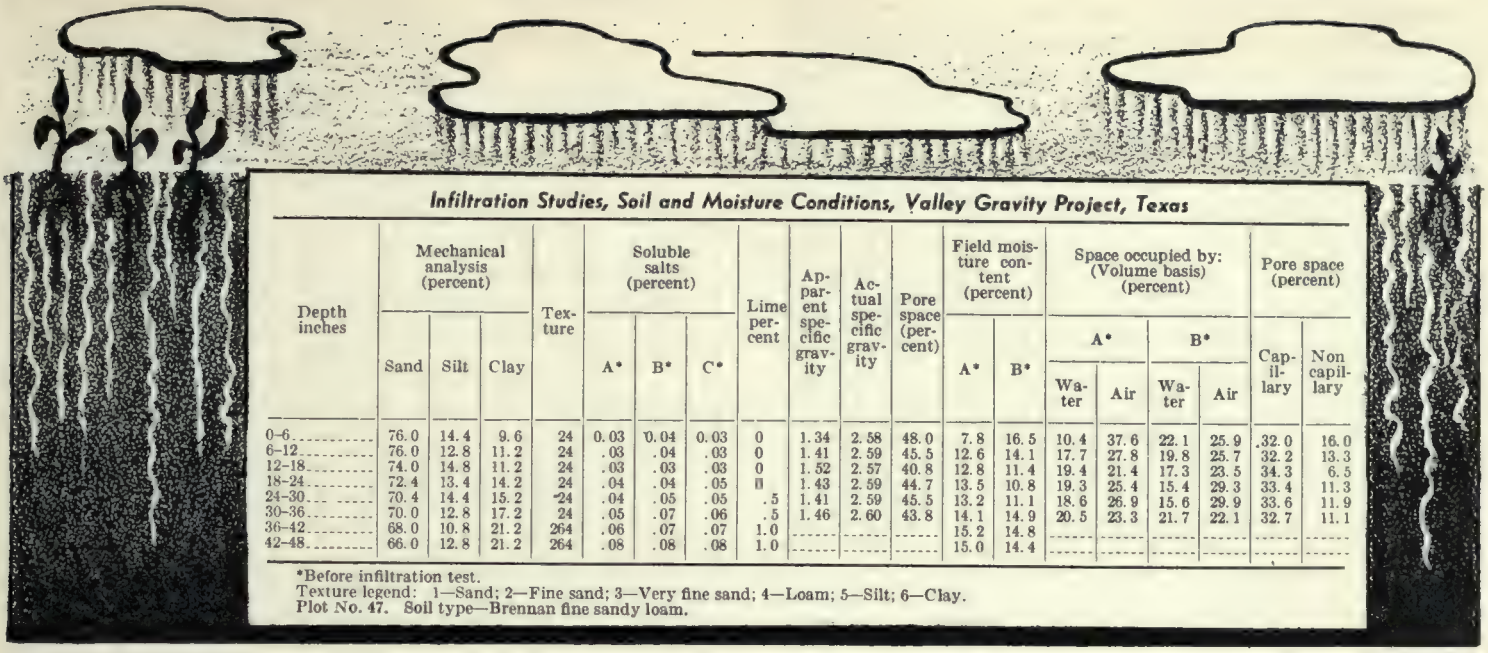
So far, the infiltrometer may appear to the uninformed like just so much junk from a boiler room put together so that it will squirt water. Not so! When rain falls, the hammering of the droplets compacts a thin layer of top soil with the result that there is some sealing effect and consequently more run-off and less infiltration than when water is applied by hose, irrigation, or most other means. In other words, to get results we had to simulate rain, not just sprinkle water on the ground. When it rains, each drop has a definite size; moreover, it falls with a characteristic terminal velocity or speed when it contacts the earth; this determines the extent of sealing and consequently the amount of run-off. In addition, the storm had to be uniform over the area tested for usable results. We couldn't have a 10-year storm on one side of the experimental plot and a 5-year storm on the other at the same time and expect to get by. When one considers those three fundamental requirements: drop size, terminal velocity, and uniformity of distribution, the equipment ceases to be plumbing and becomes a highly specialized, temperamental, delicate instrument used for observations of a highly scientific nature. (I'll bet the nuclear lads at Oak Ridge would be jealous.)

After considerable revision of plans, discussions, building and rebuilding, and test runs, we had about what we thought it would take to do the job. The rig was then mounted on several old, beat-up ton-and-a-half trucks and put through its paces. (New trucks are still hard to get, or hadn't you heard?) It took seven men and some boys to run the thing, what with pressure gages, precise sampling with laboratory glassware, recording, pumping, etc., to be tended to simultaneously. It was like an operating room, except the equipment wasn't sterilized and no one wore white.

Rain Maker in Action

The infiltrometer in its final form consisted of four accurately built border plates which enclosed a rectangular area exactly 6 by 10 feet. On each long side was installed, independently of the plot, a system of six complicated nozzles which would do all those fancy things with the raindrops mentioned previously. On each set of nozzles was a pressure gage and a valve so that pressure could be kept constant throughout the test. This entire part of the apparatus was enclosed in a tent so that the Gulf breezes wouldn't influence the test. The water supply consisted of clean city water in a 700-gallon tank mounted on a truck. A pump and motor capable of maintaining a constant minimum capacity of 15 gallons per minute at 110 feet head carried the water from tank to nozzles. Hoods were provided for the nozzles which could be simultaneously raised or lowered in an instant by moving one lever outside the tent. When the hoods were up, it rained on the plot; when they were down, the water ran into a metal gutter and out of the tent, to be wasted. To calibrate the storm, a 6- by 10-foot pan was provided, which fitted snugly over the enclosed plot. This pan had a run-off

At left: "Undisturbed" soil sampling device completely assembled. The tube, with an inner tube made of 6-inch segments, is being forced into the ground with a hydraulic jack. The supports are soil augers held down by chains. Below: Measuring run-off sample during infiltration test. Sample is being poured into graduated measuring cylinders. Man at right is pressure valve attendant.



Infiltration Studies, Soil and Moisture Conditions, Valley Gravity Project, Texas

Depth inches	Mechanical analysis (percent)			Texture	Soluble salts (percent)			Lime percent	Apparent specific gravity	Actual specific gravity	Pore space (percent)	Field moisture content (percent)		Space occupied by: (Volume basis) (percent)				Pore space (percent)	
														A*		B*			
	Sand	Silt	Clay		A*	B*	C*					A*	B*	Water	Air	Water	Air	Capillary	Non capillary
0–6	76.0	14.4	9.6	24	0.03	0.04	0.03	0	1.34	2.58	48.0	7.8	16.5	10.4	37.6	22.1	25.9	32.0	16.0
6–12	76.0	12.8	11.2	24	.03	.04	.03	0	1.41	2.59	45.5	12.6	14.1	17.7	27.8	19.8	25.7	32.2	13.3
12–18	74.0	14.8	11.2	24	.03	.03	.03	0	1.52	2.57	40.8	12.8	11.4	19.4	21.4	17.3	23.5	34.3	6.5
18–24	72.4	13.4	14.2	24	.04	.04	.05	0	1.43	2.59	44.7	13.5	10.8	19.3	25.4	15.4	29.3	33.4	11.3
24–30	70.4	14.4	15.2	24	.04	.05	.05	.5	1.41	2.59	45.5	13.2	11.1	18.6	26.9	15.6	29.9	33.6	11.9
30–36	70.0	12.8	17.2	24	.05	.07	.06	.5	1.46	2.60	43.8	14.1	14.9	20.5	23.3	21.7	22.1	32.7	11.1
36–42	68.0	10.8	21.2	264	.06	.07	.07	1.0	------	------	------	15.2	14.8	------	------	------	------	------	------
42–48	66.0	12.8	21.2	264	.08	.08	.08	1.0	------	------	------	15.0	14.4	------	------	------	------	------	------

*Before infiltration test.
Texture legend: 1—Sand; 2—Fine sand; 3—Very fine sand; 4—Loam; 5—Silt; 6—Clay.
Plot No. 47. Soil type—Brennan fine sandy loam.

trough which extended outside the tent. After the pump and motor were warmed up, the valves were adjusted to the desired gage pressure, or inches of rain per hour, and allowed to run until constant run-off from the calibration pan indicated a constant rate of rainfall; then the hoods were lowered, the pan removed, and the rain was allowed to fall on the plot inside the tent.

At first there was no run-off because the soil absorbed the rain as fast as it fell. After a while, however, rainfall caught up with infiltration and then passed it and run-off began to appear. After some time, this rate of run-off became constant, which was the condition we wanted. This ended the first test, or "A" run (dry run).

Twenty-four hours later a similar test, or "B" run (wet run), was performed on the same plot. The reason, of course, is that maximum run-off generally occurs from the storm which follows a storm which has already saturated the soil. The same procedure was followed, but the results were quite different, maximum run-off being greater and occurring earlier in the storm during the "B" run.

This was not all of the test. In order to properly interpret the data obtained with the infiltrometer other information was also required. The soils of each plot were tested to a depth of 3 feet for mechanical analyses, apparent and absolute specific gravity, capillary and noncapillary pore space, soluble salts content, and lime content. The water supply was chemically analyzed because soluble salts might influence the rate of infiltration into the soil, by causing variable viscosities and surface tensions, and therefore yield results inconsistent with those from actual rain. Of course, temperatures of the water and soil were carefully noted throughout the tests.

The work also offered valuable information on leaching and flooding effects of the water which went down through the soil and of that which ran off by indicating the degree of effectiveness of irrigation and rainfall in removing excessive, toxic soil-salt accumulations.

The principal objective of the tests, however, was the factor known as "f_c" and defined as the final constant or minimum infiltration capacity of a given soil in inches per hour. This factor ranged from a low of 0.02 for heavy clay soils to a high of 0.57 for light porous sandy loams.

This constant isn't the final answer but only a figure comparable to the retention rate of a real measured flood-producing storm in a given watershed. With this information available, the Hydrologists gave it the technical once-over, turned some mental cogs, produced hydrographs, unit-graphs, hyetographs, dimensionless graphs, distribution graphs—and came up with run-off curves for each infiltration or retention rate that are the real McCoy. A run-off curve, by the way, is another graph that tells a designer of ditches and drainage structures how much water runs into a ditch if he knows how much it rained, the area drained by the ditch, and the type of soil in the area.

This almost ends the story except for one stroke of luck which will be used to brush off the skeptical. There is an old saying down here on the Rio Grande which goes like this: "When the Valley needs rain, it gets rain." We were strangers here, however, and had never heard that, so all we had to guide us were the records of the United States Weather Bureau. About the time the infiltrometer work was completed the bottom fell out and along came a storm about equivalent to the average ten-year frequency. We must live right, as this was too much to hope for; if offered opportunity to check the results obtained artificially against the real thing. And were the results good? Believe it or not, they were.

We do not claim that the infiltrometer is a cure-all, nor can we state unequivocally that our use of it was new. It has been used extensively by the Forest Service and the Soil Conservation Service in Texas, Kansas and California, but so far as we know, what we did at Valley Gravity could be called, without too much fear of contradiction, a successful operation.

(Continued on next page)

At any rate, the Hydrology Division, Branch of Project Planning, who are not known by their eagerness to latch on to a new thing that hasn't proved itself, decided to take over the infiltrometer equipment (old trucks and all) which was by then as useful as a slide rule in the dark, and apply procedures pioneered in Region V, on all Reclamation projects where necessity dictates. We'll all be hearing more of it.

For readers who begrudge an engineer his lighter moments and desire more specific information, we refer them to a well known journal of civil engineering in which it is intended to report full technical details in a long-haired symposium. THE END.

EDITOR'S NOTE: At the time Mr. Maierhofer wrote this article, he was in charge of drainage investigations for the Valley Gravity project in Texas, which is under the administrative supervision of the Regional Director at Amarillo. Previously he had been active in other regional drainage matters. Following the retirement of John R. Iakisch, former Chief of the Drainage Section, on August 31, 1948, Mr. Maierhofer was appointed Acting Chief of the Drainage Division in the Denver offices.

Six of One . . .

About 40 years ago a homesteader on the present Columbia Basin project of Central Washington, where rainfall averages 6 inches per year, was sitting on the shady side of his homestead shack one hot June afternoon when an old car stopped in front of his desert home. The driver needed water for the radiator and inquired if the homesteader could furnish the necessary aqua pura. The forlorn dry farmer led the tourist to a barrel, took off the lid and said, "Help yourself."

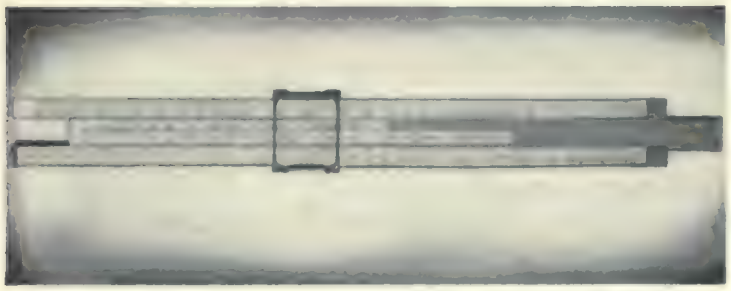
"Where do you get this water?" the tourist inquired.

"From the railroad siding 5 miles away," replied the settler.

"Why don't you dig a well?" asked the tourist.

"Oh, it's the same distance and harder work," explained the farmer.

Slide Rule for Weed Control



Nearly everyone is acquainted with the phenomenal growth of the use of 2,4–D for weed control. Many thousands of acres have been treated this year for annual and perennial weeds and woody plants, and experience has shown the importance of applying the right amount of the chemical. Overdosages may cause injury to crop plants while not using enough chemical to do a good job may be a waste of time and money.

Mr. L. S. Evans, Agronomist of the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, has devised a means for computing problems involving the use of 2,4–D which may aid in obtaining the proper application. The variables encountered when applying the chemical on a field scale are: gallons of the solution per acre, miles per hour of the equipment to be used, spacing of the nozzles, and gallons of solution per hour. With Mr. Evan's device any one of these variables can be determined if the other three are known or assumed.

The device consists of an inexpensive engineer's slide rule (some can be purchased for as low as 25 cents) from which the original scales have been removed and new ones substituted on 3-cycle semilog paper as shown in the above photograph. The variable to be determined is computed by using one of the following formulas and corresponding manipulations on the slide rule:

(1) $$GPH = GPA \times 0.01 \times MPH \times inches$$

(2) $$GPA = \frac{GPM}{0.01 \times MPH \times inches}$$

(3) $$Inches = \frac{GPH}{0.01 \times MPH \times GPA}$$

(4) $$= \frac{GPH}{0.01 \times GPA \times inches}$$

When:

GPH = gallons per hour per nozzle.
GPA = gallons per acre.
MPH = miles per hour.
Inches = inches between nozzles.

For example; to determine the gallons applied per acre when one nozzle discharges 4 gallons per hour, the nozzle spacing is 12 inches, and the forward speed of the sprayer is 5 miles per hour, use formula (2) above, and

—Set 12 on I scale opposite 4 on H scale.
—Move hairline to 5 on M scale.
—Read A scale under hairline = 6.7 gallons per acre.

It is believed that this quick method will be of particular value to custom spraying operators. However, it can be used equally well by farm operators who do their own spraying and if it seems to be a bit complicated it should not be difficult to find an engineer on an irrigation project who can give a more detailed explanation of the method.

A similar computer can be made for the calculation of problems where it is desired to determine the quantity of liquid or solid commercial 2,4-D formulations required for small experimental plots which will give a rate of application equivalent to a known number of pounds of 2,4-D expressed on an acre basis. However, this modification would be the most useful to those interested in test plot work. Full directions for making a rule of this type can be obtained by requesting the information from the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, Beltsville, Md.

Irrigation Laboratory at Santa Paula

By R. G. HOWARD,
Region II, Sacramento, Calif.

TED SHARP IRRIGATES TWO HUNDRED FARMS. To be exact, Ted Sharp tells two hundred farmers how to irrigate and they love it.

He tells them exactly what to do and exactly when to do it. But from one year's end to another, you'll never hear a word about "paternalism," "crackpot professors," or criticisms like "all right in theory but no good in practice."

The reason is simple. The orange, lemon, and walnut growers on 4,000 acres of land around Santa Paula, Calif., realize that you don't fool around with $3,000-an-acre groves trying this and trying that, or guessing and ruling with your thumb, any more than the owners of a $12,000,000 company which must produce a high quality product would handle their production problems by guess and by golly. No, you do just like the corporation management would do. You hire a highly qualified expert and give him a field staff sufficient to keep checking on conditions everywhere along the manufacturing line, and you listen with respect to his recommendations and carry them out.

That's why, when a grower gets a note from Mr. Sharp recommending that he irrigate or apply fertilizer, he carries out the instructions to the letter.

The Santa Paula growers learned the hard way. Nearly 25 years ago it became apparent to a number of fruit growers in that locality that their fruit and trees were suffering, probably because of wrong irrigation methods. Too much fruit was of low quality and too many trees were sickly and short lived. It looked as if too much water or water at the wrong time was causing it. With high production costs you could lose money hand over fist, if volume and quality declined even slightly. Better fruit wouldn't cost any more money—probably less.

The Santa Paula growers were people who were able to draw reasonable conclusions from hard experience. Instead of blaming the Lord, or the economic situation, or each going separately along the road he thought best to correct conditions, they decided to set up a laboratory to find out exactly what they were doing wrong. Accordingly, a number of fruit-grower associations jointly sponsored the laboratory under the name of "Fruit Growers' Laboratory, Inc." They picked Ted Sharp to handle it because, even then, he was recognized as a competent agricultural technician with a thorough knowledge of, and deep respect for plant–soil–water relationships.

Ted Sharp had certain sound scientific ideas. He believed that irrigation isn't just "watering," but instead is a very serious major soil treatment. Dry permeable soil (a perfect conveyor of moisture to where it's needed) is changed to mud (a substance with entirely different properties), by irrigating—which means the application of more water than a normal rainstorm. In addition, the mineral content of irrigation water, even though small in percentage, usually adds up to far more in weight and importance than that applied through fertilizers. Altogether, he felt that over-use of irrigation water was one of the worst practices of irrigated agriculture. He knew that types of trees differed widely in their needs and tolerance of water. Most important, he knew that generalizations about how to handle a particular tree crop were almost worthless because every acre of the land the crop was growing on was likely to differ substantially in fertility, mineral requirements, moisture holding capacity, and the need for drainage.

Soil samples to determine moisture content are taken from 0–12-inch zone and 12–30-inch zone in citrus groves with a third and deeper sample taken in walnut groves. Two samples are taken at each site and mixed together to yield a composite sample. *Photo by A. J. Burrows, Region II.*

So Mr. Sharp had a pretty good idea of what he was going to do when he set up the laboratory. Over the years the work has been systematized to a maximum.

If a new orchard is to be studied, Mr. Sharp or his assistant, Mr. E. J. Curran, goes with the sampling crew to the field and selects representative locations. Successive samplings are made at the same sites. For oranges and lemons, two samples are taken to determine the conditions in the surface to 12-inch zone and in the 12- to 30-inch zone. In walnut groves, a third and deeper sample is obtained. Each sample is a composite from two holes. The number of samples taken

Top photo: E. J. Curran (at right), Assistant Director of Fruit Growers' Laboratory, Inc., explains to R. G. Howard, Bureau of Reclamation, an example of over-irrigation where too many small streams result in excessive use of water which will probably damage trees. Middle photo: Quality of water determination and other requisite chemical tests are made by Chemist Ruth Hardison of the Laboratory. Bottom photo: General view of building which houses the Laboratory. *All photos by A. J. Burrows, Region II.*

depends on the size of the orchard, but usually represents about one location per acre. Mr. Sharp feels that all these locations are necessary. Experience has taught him that conditions vary so much within a single field that fewer samples do not present a true picture. As they take samples, the field men note the general conditions, appearance of trees, signs of moisture, and similar factors. They report their opinions of moisture conditions and the need for irrigation. The fact that even after long experience they quite often miss the moisture percentage badly, points out the necessity of laboratory determinations of moisture content.

The samples taken by the field men are carefully weighed in the laboratory and oven-dried to determine moisture content. By comparing the moisture content with the wilting points (point at which plants will wilt) of soils previously taken from the same location, Mr. Sharp can estimate within a few days the proper time for irrigation. He keeps a record of all reports on every field and after a number of such reports, he can estimate quite accurately the rate of moisture use and can predict very closely the proper time for reirrigation.

Mr. Sharp interprets the reports of field men and laboratory technicians and makes his recommendations to the farmer. In his report, Mr. Sharp tells the farmer when he should irrigate, how much water to apply, how to apply it to best advantage, and how to tell when he has irrigated the proper amount. He also tells whether to add fertilizer and how much, depending on the laboratory analyses of the soil and water quality. His instructions to the irrigators are concise, practical and easily understood. There is no opportunity for the farmer to misinterpret nor is he required to read through lengthy introductory paragraphs.

A typical report to a farmer says, "Irrigate all sections August 27–September 1, two furrows on each side of tree row using 2 to 2¼ acre inches of water per acre, obtain 24 inch penetration at lower end of run." Another report says, "No irrigation until resampling, please be prepared to reirrigate around September 12 on short notice. Nitrates are declining, renitrate within 30 days." In addition, a sketch map shows the sampling locations and the percentage moisture content of the soil samples are compared to their wilting percentages.

The original cost of establishing the laboratory was taken care of by a small per acre charge on all lands within the several associations which jointly sponsored the work. Individual growers who request the laboratory service pay the annual operating costs which vary from year to year. In 1947, the cost was $8.86 per acre. The cheapest cost was for 1935–36 with $4.88 per acre. The fact that the laboratory has continued in operation for 24 years and that its work is generally growing, proves that the advice Mr. Sharp furnishes is well worth the money.

You feel that the laboratory, for Mr. Sharp, is a labor of love rather than a livelihood. He says himself that he "enjoys research work and is engaged in this work to test the theory that privately or industrially owned research or control laboratories in agriculture can survive even in the face of popular demand for public support of similar institutions."

Mr. Sharp owns several citrus groves and farms, and willingly takes advice that Tom Sharp, scientist, gives Tom Sharp, orchardist. The Laboratory takes pride in those groves under service which have lived longer or borne better than groves that have not used the facilities of the Laboratory. True enough, there are good and poor groves in and out of Laboratory service. Even under the best conditions and under rigorous technical control, it can hardly be said that farming is as yet a truly scientific procedure. He feels however, that research investigations and applied laboratory control will eventually eliminate much of the uncertainties in agriculture.

Mr. Sharp summed up the lessons of his 24 years' work when he said, "Nearly everyone uses too much water. Some trees can't stand 'wet feet.' Some soils retain moisture longer than others and some soils can reach a much lower moisture content before the crops begin to wilt. Proper water use cannot be determined here on a large-area basis. There must be careful study of soils of individual fields and rate of moisture use before an adequate program of proper irrigation can be worked out.

"What goes for citrus and walnut groves is just as valid for any other irrigated crop. We realize the importance of the scientific use of water here because our investments and operating costs are so high that a single bad year can be disastrous. But an irrigation lab, with a field-testing service, would pay for itself many times over on field crops too. If you can use 6-acre inches less water and raise the yield of barley, let's say, 3 or 4 bushels an acre, or get less lodging, you've justified your investment. And if soil fertility can be maintained by avoiding unnecessary leaching, you're building up your investment! But the biggest and most important thing is that water is always a scarce article in irrigation areas. There's nearly always more land than water to irrigate it. So when you save irrigation water, land elsewhere—land otherwise without water—can be irrigated and made highly productive.

"Every farmer can't be a scientist. But every farmer ought to have the best scientific advice available to determine the way he should irrigate and fertilize every individual field on his place. It might not be so important now when 30 percent of the income from some crops is profit. But when prices go down, a little less water and a higher yield and quality can well mean the difference between net profit and net loss. Over the long pull, scientific water use is one very important factor in ending up with a farm that can support your son and your son's son as it supported you, instead of being a wornout 'piece of land'—a wasted natural resource that will send them off to the city to work for some-

THE END.

"Reclamation Revelations—1948-49"

(Continued from page 224)

securing of funds and protecting them against irresponsible legislation by appropriation riders is one of your biggest problems. I recommend that you recognize it.

Power as the Paying Partner

Then there's a little matter of power policy. For 16 years, to my personal knowledge, that fight has been going on. The Reclamation program has taken giant strides forward under a public power law that has brought low rates, new industry, and a better way of life to the West in addition to paying a lot of irrigators' water bills. Continuance of Reclamation hydroelectric development is a prerequisite to establishing economic feasibility of most of the irrigation projects that you want because power is the paying partner. Also, with dwindling and irreplaceable oil and gas resources, it would be the acme of national shortsightedness if we did not capture, under the Reclamation law, quickly our potential hydro energy, which is wasting to the sea.

Among the pledges out—not by top-line candidates but by legislative leaders, some of whom will still be with us next January—are promises to reverse the public power program under which the West has prospered. I am proud to report that Reclamation's line has held so far, and I rejoice I helped hold that line. Not a single public power law of Reclamation is repealed to date. When the Eightieth Congress recessed, the antipublic power bills were snowing into the committees and the private power lobbyists, who don't care whether public power pays irrigation bills or not, were blocking the corridors in the Capitol. The basic legal structure still stands intact. And the country re-examined it. The Eighty-first Congress convenes in 2 months. Now let's get this power policy settled. And that's your problem.

No Fooling With Family-Sized Farms

Also, there's that not-so-little matter of Reclamation's acreage restriction designed to keep it on the basis of the greatest good for the greatest number. Under it, Reclamation has prospered since Uncle Sam went into the irrigation business in 1902. Some of you do not like this family-sized farm requirement. Certain groups principally from California with some Texas support, which you can name as well as I can, have spent a lot of their time and more of other people's money to bust that wise provision. It always has been and still is my judgment that most of the members of this association and, certainly, most of the public supported that provision. It has been assailed, impeached, and lied about for the last several years, and parallel treatment is assured in advance to its supporters. But I am proud again to say that it remains intact and inbedded in the law. I believe we can keep it there and I hope that's settled. I hope the National Reclamation Association will not again go on record, as it will be urged to do, in favor of providing interest-free Federal Treasury funds to perpetuate corporate farming through irrigation for the big fellows and resultant exclusion of veterans and others who might be the real builders of the West.

Now some people have pledges out to throw it in the ash can next year as they tried to do and failed this year and last. I make to you now a positive policy recommendation that, for the good of Reclamation, you preserve the principle of the family sized federal irrigation farm. And that's another one of your problems.

No Looting of Reclamation Law

A lot of fancy footwork has been going on in some States to get water outside the principles of Reclamation by assorted dodges and subterfuges such as calling irrigation, "flood control" to get water for free or making exceptions to the

Reclamation Law. That law, which you wrote and which is your Magna Charta, will only survive if applied justly and without discrimination. It is doomed if it is made inequitable and a travesty by wholesale exception. You and I have supported uniform and nondiscriminatory liberalization of the Reclamation Law. It will be liberalized but it must not be looted, or Reclamation and the West will not prosper. Again, this Reclamation policy of full repayment for irrigation investment without interest is still intact. I want to recommend that it be preserved and that you all work together to get a recognized and uniform liberalization preserving the basic principles or nondiscriminatory repayment and not try to run the ends or steal an advantage one over the other by subterfuge. And that's your problem.

But perhaps the greatest problem of all that is before you as an association is what kind of an association you are going to be. As dues-paying members of this association, we have seen a few changes going on in N. R. A.—some of which are, in my opinion, bad. This Association was founded to foster and support Reclamation in the development of the West. To most of us, it is and can continue to be what it purports to be. But it is in peril. It houses a lot of varying and conflicting views. But, beyond that natural democratic conflict, in recent years some interests moved in that have special ends. They are not Reclamationists or water users. They are powerful corporations or corporate agents and employees who paid a good price for admission and claim the paymaster's privilege of calling the tune.

We do not like to talk about it very much in these meetings but the monopolists—certainly power monopolists and some fellow traveler land and water monopolists—are with us today. There were 59 members affiliated with public utilities the last time Congress saw the score, and nobody revealed how much money they put up. Now these utilities, according to their own testimony in Congress, are more interested in preserving their own power monopolies than advancing Reclamation. It is their undeniable right and privilege to protect their monopolies if they so desire. And you can rest assured that the power utilities can be trusted to care for themselves without the National Reclamation Association carrying that burden for the power companies.

No Cuckoo's Nest in the West

They may be just as sincere and honest by their lights as is the cuckoo bird which is famed for laying its eggs in another bird's nest to be hatched by deceived foster parents. The National Reclamation Association was organized by the West for its own legitimate purposes to hatch its own eggs. A cuckoo bird steals the eggs from the nest it invades and substitutes its own.

So, you have before you the proposition of determining whether the National Reclamation Association is going to be what its constitution provides—an association "to promote the development, control, conservation, preservation and utilization of the water resources of the Reclamation States" —or whether it is going to be made a camouflage and a shell—a cuckoo's nest used to hatch the eggs of special and monopolistic interests.

There is no reason why this association must become a cuckoo's nest or even a vocalizing roost for the cuckoo in charting western policy. Perhaps the individuals sponsored by corporations put up the heavy money and have become super-industrious and super-articulate in voicing their own views under the Association's banner. But in membership, according to the rolls, the corporate representatives are only a bit over 10 percent of the total. The majority of real irrigationists who want to advance Reclamation above all else can call the tune in harmony with our constitution any time they organize or insist on so doing.

So that you won't be misled into thinking that this is only personal opinion, there is here placed before you from the Congressional Record a resolution which has been sent you by one of your constituent State Associations since we met last year. That State Reclamation Association at its annual meeting passed this as its Resolution No. 1. It reads as follows:

> WHEREAS, we recognize that the greatest obstacle to progress in the field of Reclamation is the subversive influence of special interest groups, and
>
> WHEREAS, these groups operate under various pretenses as interested in the public welfare and under names often misleading, and
>
> WHEREAS, Associations with genuine interest in progress are frequently infiltrated with a purpose to hamper their efforts,
>
> NOW THEREFORE BE IT RESOLVED; that we urge state associations and the National Reclamation Association to safeguard democratic processes in their activities and to avoid undue influence of special interest groups seeking selfish ends.

That's the resolution of your State association. You now have it before you. It remains undisposed of. And that resolution No. 1 is your problem No. 1.

I enjoy being with you. Many of you are my friends and have been my friends ever since long before I took over as Commissioner in 1945. You and this organization have done great works. It is my good fortune to have become the postwar Commissioner who served as Reclamation was revitalized. It was my humble privilege to serve during three years when Reclamation received nearly $600 million to carry on—a sum approaching half the total that the Nation appropriated to Reclamation in the 46 years of its existence. Many, many people made that possible. Many more people will have to do other things if the full possibilities of Reclamation are to be realized.

This country has just concluded a great political debate. All these principal questions that I have raised today were issues in the Reclamation States. The verdict was rendered by the greatest jury in the world—the American electorate—on November 2.

Today, as a result, there is open to this association and the West an opportunity to move forward on all Reclamation fronts which is without precedent. That movement can be of a scale and scope dictated by the economy of today and tomorrow and not of yesterday or 20 years ago.

To seize this chance it is necessary to abandon the squabblings that have divided and weakened Reclamationists and this association. There never was—and perhaps there never will be—a better chance than in the coming months. You have a pledged administration with a fresh mandate and a united Congress than can bring the West what it needs in irrigation and power as never before if you heed the verdict—and if Reclamation, this association, and the West present a united front.

For Reclamation, which I have been in only because I wanted to be in it and where I expect to remain, I pledge you our best effort to seize this opportunity. The time is now and the chance is ours.

God bless you one and all!

An account of the Seventeenth Annual Conventiton of the National Reclamation Association will appear in our January issue.—Ed.

News Round-Up

Night Into Day at Hungry Horse

In order to make possible "round the clock" construction at the Hungry Horse dam site, Montana, General-Shea-Morrison, the contractors, have started installing "star" lights. These powerful lights are suspended over the canyon about 500 feet above the river and will afford general illumination to the scene of operations. The first string, slightly downstream from the dam site, was started about the middle of September. Another will be swung across the river upstream from the site. Night construction activities will offer a spectacular view from the access highway, but visitors are urged to be extremely careful when driving to the dam site at night.

The Interior Department Appropriation Act for 1949 (H. R. 6705) carried a "rider" or amendment for the payment of salaries or expenses after January 31, 1949, to the Commissioner, Assistant Commissioners, or Regional Directors, of the Bureau of Reclamation, who have had at least five years' engineering and administrative experience. This "rider" was aimed directly at the removal from office of Commissioner Michael W. Straus and Regional Director Richard L. Boke, of Sacramento, California, neither of whom is an engineer. It was attributed to resentment in certain quarters over the enforcement by these two officials of public power and acreage limitation provisions of the Reclamation Law in California and followed an "investigation" by a subcommittee of the House of Representatives.

President Truman, at the special session of Congress in August, recommended repeal of the "ouster" amendment and will renew his recommendation when Congress reconvenes in January 1949. With the change in the political complexion of both Houses of Congress as a result of the November 2 election, President Truman's recommendation for repeal of the "rider" is expected to receive favorable consideration. During his successful campaign, the President advocated the public power and acreage limitation policies which Straus and Boke have defended.

In any event, the "rider" applies only to the payment of salaries, and not to the exercise of official duties. Pending action by Congress, Messrs. Straus and Boke will continue in their respective positions.

Willwood Repayment Contract Approved

William E. Warne, Acting Secretary of the Interior, recently approved the draft of a repayment contract between the water users on the Willwood Division of the Shoshone project, in northwest Wyoming, and the Federal Government.

In substance, this draft of the contract is acceptable to the Wildwood District Board and the Bureau of Reclamation, and paves the way for ultimate final negotiations leading to acceptance by the water users, execution of the contract by the Irrigation District and the Secretary of the Interior for the United States and eventual approval by the Congress.

The proposed contract calls for repayment by the District of $1,500,000 which will cover the costs of construction to date, as well as construction in progress, which is necessary to complete the Division. Also included in the total are certain rehabilitation costs providing for work necessary to assure that the irrigating system is in good condition when turned over to the water users for operation and maintenance under the terms of the contract.

Settlement on the Willwood Division, where approximately 12,000 acres of land are being irrigated, began in 1928 and progressed slowly through the years of low farm prices during the depression.

The water supply which is obtained from the Buffalo Bill Reservoir on the Shoshone project insures the production of an abundance of forage, as well as beans and other irrigation crops in a flourishing livestock area.

Everett T. Giles Retires

Everett T. Giles of Amarillo, Tex., veteran Reclamation employee, retired as special engineering assistant to the Regional Director at Amarillo on June 30. He had been with the Bureau continuously since 1917, with the exception of four years during which he worked with the Corps of Engineers, War Department, as Special Irrigation Engineer.

He saw service on many Reclamation projects including Strawberry Valley in Utah, Colorado River and Rio Grande in Texas, as well as in the Commissioner's Office in Washington where he spent several years as Chief of Planning and Liaison Section, Engineering Division. After leaving Washington, D. C., he joined the Region V staff at Amarillo, Tex., where Wesley R. Nelson, now Assistant Commissioner, was Regional Director at that time. His vast experience proved an invaluable aid to Mr. Nelson in setting up a smooth running organization and solving many engineering problems in his assignment.

Summit City Water Rental Contract Executed

Acting Secretary of the Interior William E. Warne recently executed in behalf of the United States a long-term municipal water service contract with the Summit City Public Utility District of California.

This service will alleviate a shortage of municipal water suffered by Summit City area for many years because of the necessity of pumping from wells, a source inadequate in dry seasons and one which, according to tests, is contaminated.

The Summit City district, located 2½ miles south of Shasta Dam, key feature of the Central Valley project in Shasta County, will obtain the water from Shasta Reservoir through the Government's enlarged pumping plant and ten-inch pipe line which also serves the Government camp at Toyon, Calif., and the Shasta Dam Area Public Utility District. Maximum rate has been set at 20,000 per acre foot, which is equivalent to about 326,000 gallons.

The Low-Down on Ground Water

(Continued from page 230)

you can get a great deal of water through it. All the water you pump out of your well has to go in through your screen and has to go through the gravels immediately surrounding the casing, so the process of development is to wash those fine materials out and get a good flow of water into the well. Occasionally you will find formations that have so much fine sand of such uniform size that your well will just keep pumping sand. That condition can sometimes be overcome with artificial gravel packing—in other words, by introducing a layer of gravel around the outside of the casing or screen to form a gravel envelope that will hold back the finer materials and allow water to collect and flow into the well.

There are a number of methods of developing wells. Some people use dry ice. Some people use acid where they have a lot of lime cemented formations. Other people just simply put in an old pump and surge the well by turning the pump on and off. When you turn the well off, the water in the column pipe rushes back down the well and out into the formation and produces an agitating effect that will tend to wash those fine materials back into the well where they can be removed. Gravel packing of wells requires very careful manipulation and sometimes runs into a good deal of money.

The cost of well drilling varies so much that it is very difficult to give a general figure. I have been in areas where the costs run from two dollars to twelve dollars a foot, depending upon the diameter. Some drillers estimate the cost of drilling to be the cost of the casing plus a fixed fee. Pumping costs likewise vary greatly from place to place depending upon the cost of power or fuel. In one place where I've worked, it takes about two kilowatt-hours of electricity to pump an acre-foot of water through a lift of one foot, so you can see that every time you drop your water level a foot it costs you just a little bit more to pump it. In some of our western valleys the water level has dropped or declined as much as 100 feet. If prices of agricultural products drop, some of our pump irrigators will find it very difficult to make ends meet. THE END.

EDITOR'S NOTE: *The above article was adapted from the transcript of a meeting held at Goodland, Kansas, at which Mr. McDonald appeared as the principal speaker before the Goodland Rotary Group.*

Long-Range Agricultural Policy and Program

The Committee on Agriculture and Forestry of the United States Senate has published a report (S. Rep. No. 885, Eightieth Cong., second sess.) entitled "Long-Range Agricultural Policy and Program." The subcommittee preparing the report held extensive hearings both in Washington and in various regions throughout the Nation.

Following are some excerpts from the report which are of particular interest to the Bureau of Reclamation:

BASIC OBJECTIVES

A major objective of a long-range agricultural policy is to achieve an abundant production of food, fiber, and forest products adapted to the wants and physical well-being of all domestic consumers and to develop a strong export trade.

CONSERVATION

Maintenance of an abundant production demands the conservation, restoration, and development of our soil, water, and forest resources.

The conservation, restoration, and development of our soil, water, and forest resources pose one of the most serious long-range problems facing American agriculture.

There should be more adequate provision for the coordination and expansion of Federal and State soil surveys and other investigations, and for experimentations and research pertaining to the conservation, restoration, and development of our natural agricultural resources.

FAMILY-SIZE FARM

The owner-operated family farm, long an accepted ideal of American farm policy, needs to be continued and strengthened as the basic type of unit of our farm economy.

A successful farm must use the labor of the operator and his family effectively and make efficient use of capital, machinery, and modern technology. * * * The family farm must also provide an adequate income for the farmer's family to purchase the quantities of goods and services required for a good level of living.

Size of farms must be kept flexible because farm families differ widely in their technical knowledge, managerial capacity, and desires to operate particular types of farms. Furthermore, because of soil, topography, and other natural conditions, farms are not adapted to any standard size for economic operation.

RESEARCH AND EDUCATION

Agricultural progress is dependent upon increasing production per worker through continued advancement in agricultural technology and science based upon expanded research, experimentation, education, and demonstration.

It seems clear that action agencies, with definite programs to administer, should in no respect be responsible for research conclusions as to the effectiveness of their own accomplishments. Those directly responsible for basic research and those concerned with the administration of action programs should be independent and responsible only to the top officials in either State or National agricultural administration. Research workers should never be placed in a position in which they can be accused of letting the stated objectives of a program and its administration confuse and bias the analysis of the accomplishments of that program.

While farm people are now adopting new production techniques and are improving farm practices more readily than at any time in the past, there remains a major task of teaching and demonstrating new or improved farm and home methods to rural youth and adult farmers as they developed. The Extension Service was organized to do this work and has demonstrated that it is qualified to do the job.

COORDINATION

The widespread criticism by farm people to the effect that various existing agencies are carrying on duplicating services, that advice to farmers frequently does not meet local needs, that recommendations of the several agencies frequently differ, that some agencies disregard or oppose other agencies, and that recommendations frequently do not recognize the farmer's financial situation are potent arguments for more effective coordination of all agencies at local, State, and National levels.

The State agricultural experiment stations and the research agencies of the United States Department of Agriculture have contributed to solving many agricultural problems in the interest of an abundant, low-cost food supply. The research and educational work of these agencies should be substantially increased.

Although the division of responsibility between the various levels of Government is not well defined, many phases of long-range agricultural policy are the responsibility of the several States.

The foregoing excerpts are not intended to cover the report in its entirety or to indicate its scope, but are confined to those parts which are of special interest to the Bureau of Reclamation.

Above: Minidoka Dam on the Minidoka project located on the Snake River in Idaho was constructed in 1909. Dam is of rock-fill, faced on upstream side with impervious earth-fill, and creates reservoir known as Lake Walcott, with storage capacity of 107,240 acre feet. The power plant has 7 generators with a kilowatt rating of 13,400.

Above: American Falls storage dam and the Idaho Power Co. dam on the Snake River. Center box: Arrowheads, knives, and spears found along Snake River and American Falls and Lake Walcott reservoirs. A number of these were found by D. G. Martin, pioneer engineer, who located many of the canals on Minidoka. *Photos by F. B. Pomeroy, Region I.*

Speaking of Settlers

By LYNN CRANDALL,
Watermaster, Water District No. 36, Idaho Falls, Idaho.

Relics of prehistoric days furnish mute evidence of the truly "original" settlers of the West.

In any of the older towns on the western reclamation projects one may still find some of those men and women who settled there when the projects were first built. They grubbed the sagebrush and built the first homesteaders' cabins and used the first water that was turned into the ditches. Today we enjoy listening to their stories of the early days and honor them personally while we are still able to do so.

In doing this, however, we should not forget those earlier nomadic occupants of these lands—the American Indians. One of the darkest pages of American history is that upon which is recorded the white man's treatment of these original Americans, how he expropriated their lands, destroyed the game upon which they lived, and decimated their numbers by slaughter and diseases such as smallpox.

They were here long before any white man knew of this continent. Among the sand blow-outs in the Lake channel region adjacent to Lake Walcott and along the beaches of American Falls Reservoir, Idaho, an experienced observer can still occasionally pick up pieces of those flint or obsidian projectile points with the long longitudinal grooves which demonstrate that the so-called Folsom man passed this way some 15,000 to 20,000 years ago and paused long enough to spear himself a fish or deer or buffalo. Also can be found flint points left by the so-called Yuma man, who followed the Folsom man, with the narrow ribbon-like parallel flaking across the stone surface which no subsequent persons, either red or white, have ever been able to duplicate.

The same camp sites were occupied for many centuries by later generations of Indians, extending down to the time of the white man's appearance, but the workmanship of these later Indians in stone was generally of a cruder nature than that turned out by their earlier predecessors. These old camp sites are most easily located by the flakes and spalls of obsidian and flint that were left by the arrowmakers, and by the small piles of stones marking the location of fires. It is believed that the stones were heated and then dropped into earthen jars until the water was sufficiently heated to cook food, or that they were used in some process of cremation.

Many of the old camp sites were covered by the waters of Lake Walcott and American Falls reservoir which were created by the Government when it built the Minidoka project in Idaho. Relics can still be picked up at some of these camp sites when the reservoirs are drawn down to low levels. Many of the sites, however, are now buried beneath silt deposits resulting from erosion by waves of the bluffs surrounding the reservoirs. In places where the reservoir banks are flat and somewhat gravely, the waves have washed away the finer soil particles, and a few of the old stone and flint implements and arrowheads are washed out of the soil and can be found each fall on the exposed beaches after the annual withdrawal of stored water.

The drifting sand ridges, dunes and blow-outs are a notable feature of the landscape on the Snake River plains between American Falls and Minidoka and by some have been attributed to overgrazing. In the bottom of most of these sand blow-outs, however, there will be found the telltale marks of ancient Indian camps, proving that these features of the topography existed there centuries ago. The drifting sands cover up some of the camps but uncover others and each spring after heavy winds a diligent searcher can almost always finds a few arrowheads. The End.

Asphalt Linings For Irrigation Canals

(Continued from page 232)

parative studies on the effectiveness of the sterilants used.

Construction cost data taken on this work, while it was not too conclusive, due to the experimental nature of the asphaltic concrete installation, indicated that the cost of the asphaltic concrete lining, without soil sterilization, was substantially less than the cost of either 2-inch portland cement concrete lining, or the 1½-inch pneumatically applied mortar lining.

Based on the results of this work and previous test installations, asphaltic concrete appears to offer considerable promise as a low-cost lining. But—two questions remain unanswered, and only time can tell what the answers will be. One question is, "How much maintenance will they require?" The other: "How much will such maintenance cost?" Highways paved with asphaltic concretes are known to have long serviceable lives if properly maintained. But how about canals—our water highways? The Bureau's experience with asphaltic concrete linings, subject to many entirely different destructive agents and forces, has been too limited to permit an accurate evaluation of the probable life of these linings, and we can only estimate how much maintenance will be required and what it will cost. Therefore, these installations of asphaltic linings will be watched with a great deal of interest to determine whether they are a solution to the problem of low-cost canal linings. THE END.

Top of Dam Wide Enough for Two-Lane Highway

The top of Davis Dam, on the Colorado River in Arizona-Nevada, will be wide enough for a two-lane highway—50 feet. The dam, now under construction by the Bureau of Reclamation, will be 1,600 feet long, rising 200 feet above bedrock. The reservoir behind the dam will impound 1,820,000 acre-feet of water. The $21,462,505 contract was the largest awarded by the Bureau during the last fiscal year.

Almost 4,000,000 cubic yards of earth and rock-fill will be required to form the dam.

OUR BACK COVER

For your convenience and handy reference we suggest that you clip the list of Regional Office listings below and attach it to our back cover, a contour map of the Reclamation area.

REGIONAL OFFICES

REGION I: E. J. Newell, Regional Director, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho.
REGION II: R. L. Hoke, Regional Director, Box 2511, Old Post Office Building, Sacramento 10, Calif.
REGION III: E. A. Morits, Regional Director, Administration Building, Boulder City, Nev.
REGION IV: E. O. Larson, Regional Director, 32 Exchange Place, P. O. Box 360, Salt Lake City 8, Utah.
REGION V: H. E. Robbins, Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.
REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Long Range Program Report Available

Copies of the Bureau of Reclamation's 1948–54 Program Report are now available for public distribution. The Report summarizes field data on the development and conservation of land and water resources in the West.

It was issued at the request of Chairman Richard J. Welch (Representative from California) of the House Public Lands Committee. For copies address your request to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

Resolution Passed by Water District 12–A

WHEREAS the future growth, development and prosperity of the State of Idaho are dependent upon a full utilization of its water supply, and

WHEREAS over a long period of years the United States Bureau of Reclamation has been engaged in building and developing reclamation projects within the State, including the Minidoka project and the Boise project, two of the oldest and most successful projects in the West, and

WHEREAS these projects have long since proven the wisdom and the soundness of the development of reclamation projects and the building of homes throughout the West, and

WHEREAS Idaho has perhaps greater opportunity for future reclamation development than any other State in the West, and

WHEREAS the Bureau of Reclamation is now engaged in studying and investigating projects with a view to recommending them for authorization and development as they are proven feasible, and

WHEREAS the Bureau of Reclamation has given primary consideration to the development of projects to provide supplemental water for existing areas and is making rapid progress toward the solution of this problem, and

WHEREAS the water users of Water district 12–A feel that we in region I are exceptionally fortunate in the fact that the regional director, as well as quite a number of his assistants, are men who have lived in this area for a long period of years and are thoroughly familiar with the problems of the region, are acquainted with the people living in the region, and are most cooperative in every way.

NOW, THEREFORE, BE IT RESOLVED, by the water users of water district 12–A, in annual meeting assembled this 1st day of March 1948 that we do hereby express to the regional director of region I, United States Bureau of Reclamation, and his capable staff, our sincere appreciation of their splendid cooperation, not only in providing supplemental water for the Boise Valley and other valleys, but for their thorough, careful and painstaking consideration of the entire problem of developing the water resources of the region.

BOISE RIVER WATER USERS.
(Signed) Ed Straus, *Chairman.*
I. A. WEAVER, *Secretary.*

U. S. GOVERNMENT PRINTING OFFICE 1948

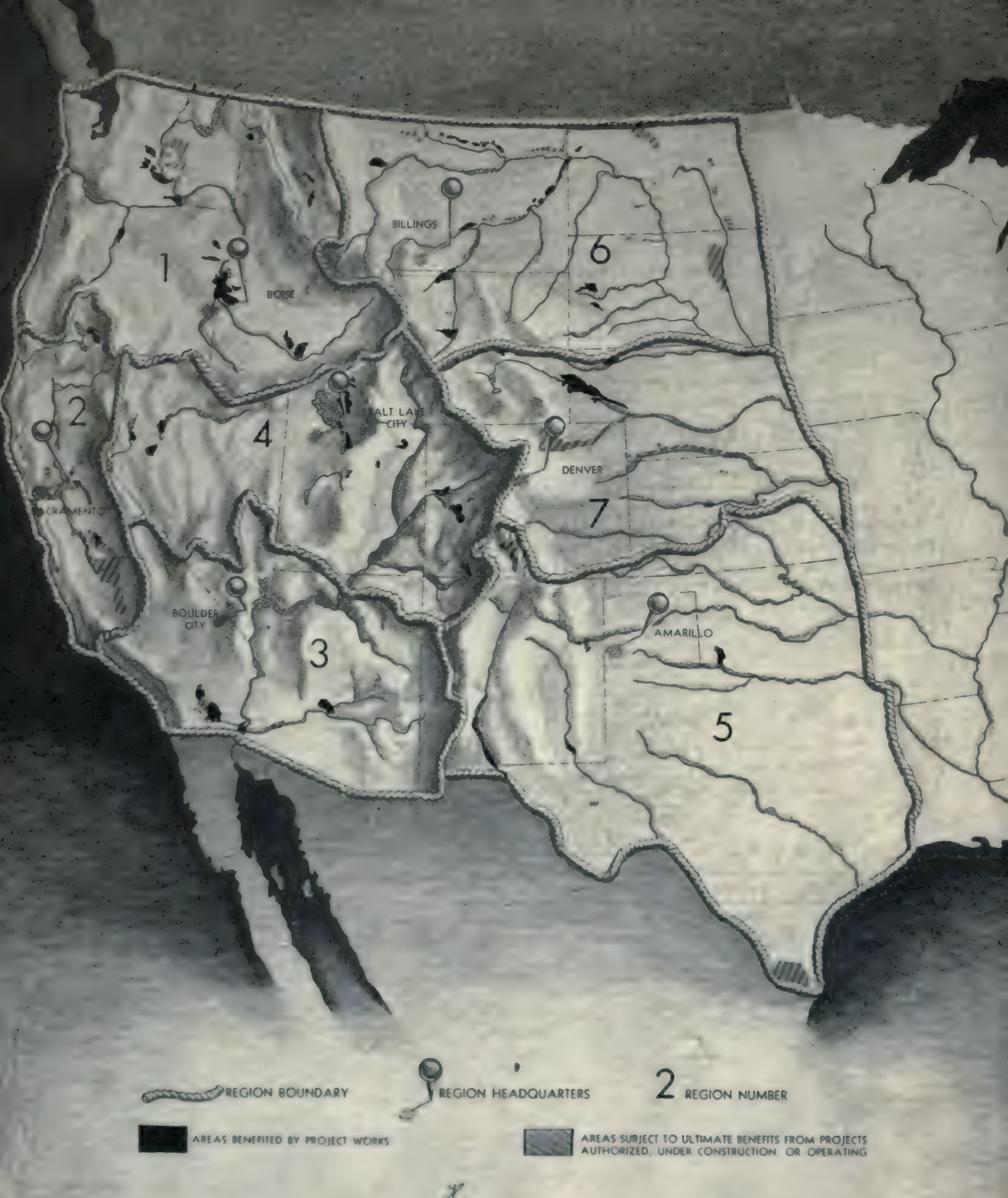
NOTES FOR CONTRACTORS

Contracts Awarded During October, 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2204	Davis Dam, Ariz.-Nev	Oct. 12	Constructing foundations and erecting steel towers for Davis Dam-Hoover Dam, Davis Dam-Prescott, and Prescott-Phoenix 230-kilovolts transmission lines.	Stolte Inc., United Concrete Pipe Corporation, Arizona Sand & Rock Co., and Ralph A. Bell, Oakland, Calif.	$2,794,686
2265	do	Oct. 7	Four 20,000-kilovolt-amperes transformers for Mesa substation, schedule 1.	Moloney Electric Co., St. Louis, Mo	525,605
2279	Central Valley, Calif	Oct. 6	Installation of three main generators in Keswick power plant	Wismer and Becker, Sacramento, Calif	146,676
2310	do	Oct. 11	Fourteen radial-gate hoists for Friant-Kern Canal, items 5 to 9	Western Gear Works, Seattle, Wash	31,275
2321	Hungry Horse, Mont	Oct. 21	Two 96-inch hollow jet valves for outlet works at Hungry Horse Dam.	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	174,500
2324	Columbia Basin, Wash	Oct. 13	Construction of Long Lake headworks, Main Canal, schedule 1	George B. Henly Construction Co., Inc., Caldwell, Idaho.	293,777
2324	do	do	Construction of canal lining and structures for Main Canal, schedule 2.	Western Contracting Corporation, Sioux City, Iowa.	1,933,391
2325	Central Valley, Calif	Oct. 1	Fifteen 15,000-volt circuit breakers and eight potential transformers for Tracy switchyard, schedules 1 and 3.	General Electric Co., Denver, Colo	172,347
2325	do	Oct. 5	Seventy-eight 15,000-volt disconnecting switches and two 15,000-volt air break switches for Tracy switchyard, schedule 2.	Cole Electric Co., Culver City, Calif	16,613
2329	Columbia Basin, Wash	Oct. 7	Production of concrete; completion of pumping plant, bus runway, and excavation for feeder canal; construction of water supply reservoir and pump discharge outlet structure; installation of pump discharge pipes; assembly of face caisson; and miscellaneous work at Grand Coulee Dam.	Morrison-Knudsen Co., Inc., and Peter Kiewit Sons' Co., Seattle, Wash.	13,348,419
2338	do	Oct. 20	One 14,000 horsepower hydraulic turbine and one oil pressure governor for unit LS3, Grand Coulee power plant.	Pelton Water Wheel Co., San Francisco, Calif	139,155
2344	Provo River, Utah	Oct. 22	Construction of pipe line and structures for Salt Lake aqueduct	United Concrete Pipe Corp., Baldwin Park, Calif.	2,429,201
2350	Missouri River Basin, S. Dak	Oct. 15	Construction of earthwork, structures, and surfacing access road at Bixby Dam.	Daane Bros. Construction Co., Sturgis, S. Dak.	12,473
2351	Davis Dam, Ariz.-Nev	Oct. 1	Furnishing and installing an electrically operated elevator for Davis power plant.	Westinghouse Electric Corp., Denver, Colo	65,041
2354	Columbia Basin, Wash	Oct. 21	Three 4,300 ampere bus structures for pumping units P1 to P6, Grand Coulee pumping plant, schedule 1.	I-T-E Circuit Breaker Co., Philadelphia, Pa	996,285
2354	do	do	Six 3,000-ampere air circuit breakers for pumping units P1 to P6, Grand Coulee pumping plant, schedule2.	Westinghouse Electric Corp., Jersey City, N. J.	207,214
2372	Yakima, Wash. (Roza)	Oct. 8	Construction of earthwork, pipe lines, and structures for lateral distribution systems for pump areas 13 and 14.	Pfeiffer and Hohner, Spokane, Wash	118,284
2377	Boise, Idaho	Oct. 11	Installing and painting 66-inch outlet pipe, radial gates, radial-gate hoists, and miscellaneous equipment at Cascade Dam.	Humphrey-Ketchen Co., Boise, Idaho	39,901
2389	Colorado-Big Thompson, Colo	Oct. 21	Furnishing and installing one electrically operated elevator for Granby Dam.	Otis Elevator Co., St. Louis, Mo	22,748
2391	Davis Dam, Ariz.-Nev	Oct. 12	Indoor disconnecting switch hangers, cable trays, and brackets for utility building and control cable tunnel at Parker switchyard.	Gardiner Manufacturing Co., Oakland, Calif	12,390
2396	Boulder Canyon, Ariz.-Calif.-Nev	Oct. 22	Furnishing and installing one 82,500-kilovolt-ampere generator for Hoover power plant, schedule 1 (including accessories, tools, appliances, and spare parts).	Allis-Chalmers Manufacturing Co., Denver, Colo.	1,408,987
2408	Columbia Basin, Wash	Oct. 13	Structural steel for ramp, roadway, parking area, and storage building roof framing, Grand Coulee pumping plant.	American Bridge Co., Denver, Colo	136,682
2409	Missouri River Basin, Nebr	Oct. 14	Galvanized steel towers for 115-kilovolt Gering-Sidney transmission line, section B.	Do	19,200

Construction and Supplies for Which Bids Will Be Requested by February 1949

Project	Description of work or material
Boulder Canyon, Nev	Construction of additions to existing 1-bedroom brick houses at Boulder City, Nev.
Do	Processing of sand and gravel for concrete aggregate.
Central Valley, Calif	Completion of construction of Clayton and Ygnacio substations and pumping plants near Antioch, Calif.
Columbia Basin, Wash	Deicing transformers, current transformers, and disconnecting switches for Grand Coulee power plants.
Do	Extension to 6,900-volt station service switchgear, Grand Coulee left power plant.
Do	Elevators for Grand Coulee pumping plant.
Deschutes, Oreg	Rehabilitation of Ochoco dam, spillway, and outlet works. The dam is an earthfill structure about 125 feet high and 970 feet long, located near Prineville, Oreg.
Davis Dam, Ariz.-Nev	Power circuit breakers and air switches for Gila substation.
Do	Distribution transformer, step voltage regulator, switching equipment, and instrument transformers for Prescott substation.
Do	Main control board for Mesa substation.
Do	Main control board for Prescott substation.
Do	Construction of 30 miles of 115-kilovolt transmission line from Coolidge substation on Phoenix-Tucson No. 1 line to electric district No. 5 substation on Phoenix-Tucson No. 2 line, near Ely, Nev.
Do	Constructing and furnishing equipment for 15,000-kilovolt-ampere Blythe substation, located about 12 miles north of Blythe, Calif.
Do	Constructing and furnishing equipment for 10,000-kilovolt-ampere Cochise substation at Cochise, Ariz.
Klamath, Oreg.-Calif	Flap gates for Modoc pumping plant.
Minidoka, Idaho	Power transformers and oil circuit breakers for interconnection substation.
Do	34.5-kilovolt oil circuit breakers for Minidoka switchyard.
Missouri River Basin, Colo	Outlet pipes for Bonny Dam.
Missouri River Basin, Mont	Construction of about 8 miles of canal and laterals for the Savage unit (Yellowstone Pumping), near Savage, Mont.
Do	Construction of streets, sidewalks, sewerage and water distribution systems, and electrical distribution system for Moorhead government camp, approximately 5 miles southwest of Moorhead, Mont.
Do	Construction of Savage pumping plant, including intake and outlet structures and lateral distribution system, near Savage, Mont.
Missouri River Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Missouri River Basin, S. Dak	Construction of streets and sidewalks, sewerage and water distribution systems, and electrical distribution system for Bixby government camp, South Dakota.
Missouri River Basin, Wyo	Construction of streets, sidewalks, sewerage and water distribution systems, electrical distribution system, residence, pump house, and wash house; furnishing and erecting prefabricated, sectionalized, or precut wood office building and bunkhouse, prefabricated metal garage, shop, laboratory building, and warehouse; and moving and erecting 6 Wingfoot residences, for Keyhole government camp, about 16 miles northeast of Moorcroft, Wyo.
Do	Construction of about 1.5 miles of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Do	Oil circuit breakers and disconnecting switches for Boysen switchyard.
Parker Dam Power, Calif.-Ariz	Construction of 8 residences at Parker Dam, Calif.
Santa Barbara, Calif	Construction of exploratory tunnels and test pits for Cachuma dam site near Santa Barbara, Calif.
Yakima, Wash	One 12,000-kilovolt-ampere transformer, 115-34.5-kilovolt oil circuit breaker, and 115-34.5-kilovolt disconnecting switches for Roza switchyard.



The Reclamation Area